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MALARIA IN THE DUARS

BY

CAPTAIN S. R. CHRISTOPHERS, M.B., I.M.S.,

AND

Dr. C. A. BENTLY, D. PH.,

(Officers on special duty).

BEING THE SECOND REPORT TO [THE ADVISORY COMMITTEE APPOINTED BY THE GOVERNMENT OF INDIA TO CONDUCT AN ENQUIRY REGARDING BLACK-WATER AND OTHER FEVERS PREVALENT IN THE DUARS.



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MALARIA IN THE DUARS.

I.—INTRODUCTION.

It is a very common assumption that, just as an epidemic outbreak of malaria must, it is thought, be due to some unusual prevalence of anopheles or to the introduction of some species especially favouring the transmission of the disease, so an intensely malarious area must be so by reason of the existence of special facilities for the breeding of anopheles, or the presence of particularly dangerous species.

Under such an assumption the prevalence of malaria in the Duars might be put down to the particular physical features of this country especially favouring the breeding of anopheles, or to the existence of a particular species, *M. listoni*, a species which it was suggested by the Royal Society's Commission might be a factor in bringing about a condition of intense malaria.

But the facts given in the body of this report suggest that the extraordinary prevalence of malaria in the Duars—for we may state without going into details that we found malaria extraordinarily prevalent and peculiarly intense throughout the whole area—is not solely, or even mainly, the result of special facilities for the breeding of anopheles, or of the existence of a particular species, but on the contrary is bound up in what we shall call the “human factor,” an increased or diminished supply of anopheles, so long as there are any at all present, appearing to exert little or no influence upon the prevalence of the disease.

The Duars, with its 150,000 immigrant coolies aggregated in its numerous labour camps, is an example on a great scale of conditions that in our experience are practically always associated with an extraordinary prevalence of malaria. These conditions, though hitherto they have not been recognised in their bearing upon malaria, are nevertheless very distinct and important. They may, speaking

briefly, be said to be those associated with the "labour camp" in the tropics.

Labour camps, such as we refer to, must be familiar to almost everyone. They are seen in a very typical form on railways under construction, on almost all engineering projects—notably great excavation works, on operations involved in the opening up of tropical country such as clearing, road-making, laying-out and working plantations; and they are very characteristic of many tropical industries, notably, in India, coal and tea in Mauritius, sugar, and so on. The Duars—almost exclusively dependent on the tea industry—contains some thousands of labour camps, the tea coolie lines, and the conditions on a single one of these camps is representative of the whole Duars.

Without at the present going into details, we may say that in our researches on malaria we have for some time recognised the almost constant association of labour camps with severe malaria; and, whatever be the cause of this association, we believe that in it lies the explanation of the association of outbreaks of malaria with soil disturbance, opening up of new country and so on. It is not the soil disturbance, we believe, but the occurrence of labour camp conditions, or what we shall call for convenience of description THE TROPICAL AGGREGATION OF LABOUR, in association with these enterprises which has given them their evil reputation.

Anopheles under such conditions are often plentiful, especially as squalor and aggregation of human beings undoubtedly tends to foster anopheles. Not only so but the work in hand often increases facilities for breeding, and may even lead to "importation" of anopheles, a factor we believe which comes into play much more than has been supposed. But a condition of increased anopheles prevalence is not necessary for intense malaria under such conditions, and very frequently anopheles are so few in a malaria-stricken camp that it is difficult to detect their presence. The existence of extensive breeding places is even less necessary; and the common idea that these camps are malarious, because of the formation of borrow-pits and hollows is, when one has seen and studied many of them, found to be quite erroneous. The peculiar prevalence of malaria in labour

camps is, we believe, not dependent upon the number of anopheles (a certain number of which are always present), but on the human factor.

It is desirable before going further to see what is known in regard to this much neglected human factor in malaria ; for it is obvious that, if in such diseases as cholera and typhoid we were to be ignorant of, or neglect, the part played by human disseminators, we should have a very imperfect notion of the mechanism at work in the spread of these diseases, though we might know well enough that they are contracted by the swallowing of particular germs.

Koch investigating malaria at Stephensort described three types of villages :—

- (1) Villages with little or no malaria.
- (2) Villages with malaria in considerable amount, but confined almost entirely to the young children.
- (3) Villages where malaria was prevalent, not only among young children, but among the general adult population as well.

Examination showed that the population of the third type of village, instead of being fixed or permanent, as in the case of villages of types 1 and 2, was subject to fluctuation owing to causes which led to the introduction of non-immune immigrants. At each introduction of such people a sudden burst of increased malarial infection occurred, lessening as this new population became partially immune by longer residence, but showing recrudescences whenever a fresh immigration took place.

A condition of continual immigration similar to that described by Koch is conspicuously present in the Duars, Assam and elsewhere in India, where the constant introduction of non-immune immigrants may be likened to the continual heaping of fresh fuel upon an already glowing fire.

This factor, which when it acts temporarily, is capable of producing epidemic malaria and when long continued must give rise to an

increased endemicity, we shall term, for descriptive purposes the
FACTOR OF NON-IMMUNE IMMIGRATION.

But non-immune immigration does not alone constitute the whole of the human factor in malaria.

Celli in a recent reference to malaria in Italy has corrected the popular notions that the Roman Campagna is an undrained marshy tract, and that malaria there is due to want of drainage. He believes, on the contrary, that the causes at work in producing the intense malaria of the Roman Campagna are in the main bound up with the social and economic condition of the people, and especially with the hardships that the labourers have to undergo while working in the Campagna under a system which leaves them largely in the hands of the headmen and labour contractors, a statement singularly in accordance with what we shall hereafter find it necessary to make in regard to the Duars.

As regards India, Stephens and Christophers have called attention to a feature of malaria as observed by them in this country, namely that among different classes living in the same locality under very similar conditions as regards exposure to malarial infection there existed a greater prevalence of malaria among those of low social status than among those of a higher level. It is unnecessary to go further into this question beyond stating that among aboriginal tribes and certain poverty-stricken communities in India a very high endemic index of malaria may frequently be found, depending apparently upon the general squalor, the hand-to-mouth existence, and other conditions associated with low social status.

The way in which such economic conditions influence malaria seems to be in bringing about relapses and a state of continued infection. Ross, in computing the probable time during which infection may remain in the body capable at any time of being stimulated into activity by the action of depressing influences, fixes the period in British troops at about six months. In this case he was dealing with Europeans, originally healthy, picked men, well-fed, well-housed, and, under constant medical supervision. But, when we consider natives,

often originally possessed of poor physique and little stamina, living under conditions of depression, privation, and hardship pushed to their extreme, it is obvious that these form a soil far more suitable for the continued existence of malaria, and the problem therefore becomes an entirely different one, for the solution of which we at present have no data. But experience seems to show that, in a community composed of malaria-stricken subjects in a state of physiological poverty and exposed to hardship and privation, infection diminishes very slowly, even in the absence of anopheles, and, in these circumstances, the presence of a very few anopheles seems to be quite sufficient to keep up the maximum degree of parasitic infestation. In such circumstances evidence seems to point to the possibility of a few mosquitoes doing as much damage as a large number; and this, we believe, is the explanation of conditions very frequently encountered, where it is impossible to find a direct relation between the amount of malaria present and the number of anopheles. This factor, which we shall term the **FACTOR OF RESIDUAL INFECTION**, is scarcely less important in the epidemiology of malaria than the factor of non-immune immigration. Under its influence whole communities are converted into reservoirs of infection ever ready to involve their neighbourhood in epidemic disease, and capable on the migration of their members of diffusing infection far and wide.

We have thus, in addition to the anopheles factor, two great factors concerned with the human host, namely, the factor of non-immune immigration and the factor of residual infection due to physiological misery. These may occur singly or together. A famine or scarcity, it is evident, may bring about the second without the first as seems to have happened lately in the Punjab. On the other hand, we may have non-immune immigration under conditions not particularly associated with hardship. But in labour camps both factors we have described act together in their fullest intensity, and we can recognise a new state of affairs in the appearance of a system of vicious cycles always producing the same result, namely, the extraordinary exaltation of malaria. And whilst the human factor must play a part in many ways and in many circumstances, in tropical aggregation of labour it seems to be paramount and to dominate the situation.

Before going further it is necessary for us to indicate the various influences at work in such a combination and the way in which they act in relation to malaria.

Labour, whether in India, Africa, or elsewhere in the tropics, is usually of the kind known as "coolie labour." Coolies are brought together from far and wide and settled down in labour camps somewhere in the immediate neighbourhood of the scene of the operations. These more or less temporary camps may contain hundreds or even thousands of inhabitants. But they resemble neither village nor town; for the hastily erected huts which form the vast majority of the dwellings are almost invariably the rudest of temporary shelters, while the density of the populations on the camp site becomes as great or even greater than is met with in towns. Such aggregations also lack the sanitary arrangements, the permanent houses, and the material comforts of abundant food supply and a sufficiency of comparatively good water usually enjoyed by urban communities. Such camps, moreover, are just the size and offer just the amount of aggregation favourable for anopheles, which can breed over a wide area around and about them. Their coolie inhabitants are drawn from various localities, often from different provinces or perhaps even from distant countries; some come from malarious places, others from regions comparatively healthy; some are already infected with malaria, others when they first arrive are free from infection and very susceptible. Thus from the very commencement of operations month by month, even year by year, if the work extends over a long period there is an association of infected and susceptible persons eminently suitable for the great exaltation of malarial infection. Again the more unhealthy a centre becomes the greater is the loss by death, desertion and migration, and this necessitates the introduction of new recruits in increasing numbers and at more frequent intervals adding still more to the extension of the mischief.

Nor is it the immigration factor alone which becomes of increasing importance; for by the very nature of things large numbers of the destitute and needy and those feeling the pinch of necessity are in the first place gathered together along with the miscellaneous crowd of workers and not only so, but the very conditions associated with aggregation

of labour tend to cause hardship and privation. The man with no wife to cook his food, the mother without means to nourish her children, the stranger without friends, those poor physique and perhaps low intelligence, all suffer under such circumstances to a far greater extent than they would under ordinary rural or urban conditions. Prices of food are usually high and there is nothing to maintain a proper relation between the amount of pay actually received and the cost of an adequate diet : while the sum that in ordinary conditions would ensure plenty, is under such conditions often insufficient to prevent hardship and privation. Native contractors and *sardars* too in their endeavour to avoid loss or to increase their gains, and even to retain their coolies by indebtedness, adopt systems of minimum living allowances and give advances at usurious rates of interest.

Hardship conduces to sickness and this again to further hardship while every case that occurs, by becoming a source of infection, tends to increase its amount and to involve those originally the more healthy and strong, for under these conditions partial immunity to malaria, which would enable many to resist a less degree of infection, is broken down and the partly immune person suffers along with the rest. And so by a whole series of factors and combinations of vicious cycles affecting mainly the human host is brought about in the labour camps a state of exalted malaria and the formation of an epidemic focus.

The mischief does not end there. It will be gathered from what we have already indicated that along our railway lines throughout our canal zone, or scattered over an area devoted to an important industry requiring labour of this kind, there will exist various foci of malaria in the form of labour camps. In the ordinary course of things small shops and markets spring up near the larger labour camps, and villagers come in with supplies of food, also numerous petty traders and others engaged in carting and carrying operations of all kinds move constantly backwards and forwards between the new scenes of industry and the older local trade centres. As a result many small villages and, if the undertaking is a large one, even towns on the line of approach form recognised halting places, and become swollen and overcrowded by the influx of strangers. To these places come sick coolies

from the works, for nothing is so unsettling as sickness, and, as malaria in the labour camps increases, many members of families decimated by the disease endeavour to reach their homes often under conditions of great hardship. These points are very well illustrated in a case referred to in another connection by Major Leonard Rogers, I.M.S., in his report upon Kala-Azar, 1897. (P. xii, Appendix I).

“ A coolie woman, aged 19, from the Assam-Bengal Railway (then under construction) was admitted to the Nowgong dispensary during the rainy season of 1896 suffering from marked anæmia and dropsy of the feet and face. The history of her illness was that she got on all right until her father died, after which she lived with another coolie girl, and according to her story she only received about one rupee a month from the contractor (probably minimum living allowances, *vide* Chapter VI) and was consequently unable to feed herself properly. She soon became ill and as she did not improve she left the works and begged her way into Nowgong, living on what she could pick up on the way.”

The clauses in brackets are ours.

Thus it happens that new centres of infection are set up in places even many miles removed from the original source of the mischief, and once these have been established the gangs of fresh labourers travelling to the scene of work contract infection as soon as they have entered the dangerous zone, while they are still perhaps some distance from their destination. And thus by one unending train of vicious cycles once set in motion there may result a wide-spread epidemic, far-reaching and disastrous in proportion as its initial cause is extensive and important.

And again those who return to their homes or seek new seats of industry carry the infection of malaria wherever they go, and, if their numbers be at all considerable, and they must often be so, serve to assist in the dissemination of malaria throughout remote districts. Involved secondarily in the general troubles are Europeans employed upon the enterprise ; while should the conditions last for sufficiently long a period, as they have done in the Duars and other places, we may

hear of the occurrence among such people of cases of Black water Fever. It often happens that the effects upon the actual labour forces and the neighbouring native populations may pass unnoticed and unrecorded, only the outbreak of disease among Europeans attracting attention; but there can be little doubt that were such cases investigated it would be found that the infection of Europeans, troops, and well-to-do natives was only a concomitant and a result of a vastly greater amount of malaria among the poorer population, and especially among the labour force itself.

In the case of railway construction we have, then, to deal not alone with the formation of borrow-pits and the interference with surface drainage, but with a peculiar set of conditions mainly associated with the human host which are probably more or less identical throughout the tropics. In canal construction, too, we have other considerations involved beside the mere formation of water channels, which, though they may undoubtedly assist in increasing malaria, are probably not the sole cause of canal epidemics. We have labour communities engaged in the primary excavation of the main channels and subsequently drafted off throughout the district for the purpose of cutting the distributing branches, and in addition the influx of immigrants seeking to find employment and to secure land in the newly irrigated area. All these things point to a complex of factors, which it is impossible to dismiss without serious thought if we wish to understand the natural history of great outbreaks of malaria. It is obvious that in the clearing of jungle, the making of roads, and all such operations as are required in the opening up of new countries, labour is necessary; and one has only to visit a large road under construction in forest country, or a tea garden being laid out, to realise that the malaria associated with such undertakings is merely the result of the conditions we have termed tropical aggregation of labour.

Quite recently we have had the opportunity of seeing at Bombay a typical example of the malaria of tropical aggregation of labour. With the inauguration of large harbour works there has recently appeared a serious outbreak of malaria. The epidemic, we are informed, came with the works and has got progressively worse year by year

during the seven years or so in which the harbour works have been in progress. Captain Glen Liston, I.M.S., who has written on the subject, has referred to this association of the harbour works and malaria. He says :—" Moreover, it assumes an additional interest in view of the fact that the present epidemic seems to be associated in some way with the construction of the new docks."

In the few days that we had at our disposal we were able to see, owing to the kindness of Captain McKendrick, I.M.S., who is engaged in anti-malaria work in Bombay, the conditions associated with this epidemic.

The works in question covered an extensive site ; immediately outside this along the Friere Road was the part of Bombay most severely affected, though the condition of epidemic malaria extended for nearly half a mile into the city as ascertained by Captain McKendrick in his preliminary enquiries.

We satisfied ourselves that here we had, in addition to many interesting points we have not the space to touch upon,—

(1) The formation of a focus of intense malaria by a large labour aggregation.

(2) The implication secondarily of the inhabitants of Bombay.

That there existed indeed an aggregation of labour which was involving not only a few European and others connected with it, as in the Duars, but a large portion of the very heart of a populous city, a portion that should otherwise have been almost free from the disease.

As Captain McKendrick pointed out many of the houses most affected were of good class and the residents well-to-do people. Enquiry, however, elicited the fact that many coolies with no residence and but few belongings are accustomed to spend the night on the pavements ; and to judge from their accounts many have spent years in this homeless state. In the very streets most affected we saw many coolies living in this way. This state of affairs, which one could scarcely have predicted without direct observation, would in itself be sufficient to

account for the secondary infection of the inhabitants of these better class houses.

It is immaterial from our present point of view what exactly are the conditions in Bombay as regards anopheles; what we wish to emphasize is the real nature of the present epidemic. It may not be without interest, however, to point out that with the new insight we have indicated such an epidemic could have been foretold and measures could have been taken to prevent the formation of the malarial focus with much less difficulty than will now be found in controlling the conflagration to which it has given rise.

We are informed that at first labour was housed on the dock site, but that latterly it had almost all been accommodated in distant portions of Bombay. If so, we should expect the epidemic to invade new areas during the next few years, and quite possibly to extend to large portions of the environs.

Hong Kong, Wilhelmshaven and many instances of virulent outbreaks of malaria associated with works could easily be given. It is reasonable to believe after what we have said that the real determining factor in all is that of tropical aggregation of labour.

But it must not be imagined that the conditions we have been describing and the effects that we have indicated as resulting from them are to be seen only on a small scale and confined within narrow area, or that they occur only occasionally in the course of years and constitute a mere unimportant item in the epidemiology of malaria. We have seen that in the case of the Duars the inauguration and extension of an industry has produced throughout a whole district, many hundred square miles in area, an extraordinary condition of exalted malarial endemicity, characterised by the occurrence of Black-water Fever among Europeans and widespread anæmia among the natives, a condition we shall describe in relation to the malaria of a population as one of **HYPER-ENDEMICITY**.

Under similar circumstances the Darjeeling *terai* attained some years ago an unenviable reputation of a like nature; and Assam, especially in past years before legislative interference enforced the adop-

tion of certain sanitary precautions, was considered little less deadly both for natives and Europeans. In Mauritius, although there may have been a time when no suitable anopheles were present to transmit malaria, there appears to exist a typical example of tropical aggregation of labour, and Dr. Bolton's description (in Ross' Report upon Malaria in Mauritius) of the agglomerations of Indian huts scattered over the island and the "camps" on the plantations, illustrates very well the points we have alluded to. Nearly 30 years ago Hirsch appears to have connected the occurrence of the great malarial epidemic which decimated Mauritius and Réunion in some way with the laying out of sugar plantations, and although his explanation suggests a different cause to the one which in the light of our present knowledge appears most likely, his observation is significant when we remember that at that time immigration of coolies from Bengal was in full swing.

A possible example of the working of this factor of tropical aggregation of labour on a colossal scale is the series of vast epidemics of malaria which have ravaged Bengal during the last forty years, which are for the first time adequately explained by our hypothesis.

In a warm country like India there is perhaps every *a priori* reason to expect malaria to be both prevalent and intense; but if by such intensity we mean the condition so characteristic of the African coast we shall have to modify our conception. There is indeed a considerable amount of evidence to show that large tracts of India are not particularly malarious in the sense that many tropical countries are. Much of Bengal is deltaic in formation and we might expect that here especially malaria would be particularly intense; but observations upon the endemic index do not support this, and, except in certain parts liable to great epidemics of malaria, this disease does not prevent the prosperity and natural increase of the population.

Yet for many years, and more especially since the fifties, a tract in Bengal, lying mainly to the north of Calcutta and comprising the districts of Jessore, Nadia, Burdwan, Hooghly and portions of the Birbhum and the 24-Parganas, has been the site of recurring epidemics of fever which every few years have broken out first in one place and then in another. (*Vide* Map of Bengal. *Frontispiece*.)

The first recorded outbreak took place near Muhammadpur amongst a body of six hundred prisoners working on the road from Jessore to Dacca. Other outbreaks occurred in Jessore in 1846 and 1857, and in 1860-63 fever recurred to a much more alarming extent involving Jessore, Nadia, Baraset and the northern portion of the 24-Parganas. In 1867 the great Burdwan epidemic began, sweeping through the district of that name and affecting parts of Bankura, Birbhum and Midnapore. This outbreak, which is calculated to have destroyed two million people, has been attributed to Kala-Azar, but in our opinion there is not sufficient evidence that this disease was concerned, and to us it appears probable that malaria was in the main responsible.

The census of 1881 records that in 1872 the ravages of malaria at Dinajpur were greater than in any other district in the division, that by 1877 things had become still worse until at least 75 per cent. of the inhabitants were in a bad state of health, and 53 per cent. suffered from enlarged spleen, while the recorded death-rate had reached 43 per mille. In 1878-79 there was some slight remission; but in 1880 the condition returned with increased violence. In Rungpur, during the decade preceding 1880, the district increased progressively in unhealthiness until 80 per cent. of the inhabitants were reported to be anæmic, suffering from enlarged spleen, or laid up with fever, and of the 20 per cent. supposed healthy only half could be considered so in the European sense. In Rajshahi and the neighbouring portions of Pabna immediately north of the Ganges, is another area ravaged by frequent epidemics of fever, which have occurred about the years 1881, 1893 and at other times. More recently Murshidabad has been the site of disastrous outbreaks and as late as 1907 Birbhum has suffered in a similar way, while from time to time many other areas have been affected.

Over and over again, as the result of numberless enquiries, it has been stated that the factor producing these epidemics has been a change in the natural drainage of the country. But the theory that ascribes to waterlogging of the soil the occurrence of such outbreaks is probably based upon the old notions regarding malaria modified a little to fit in with our present knowledge of the mosquito

cycle of the parasite. We have never heard of any investigation having been undertaken with the object of ascertaining in what way malaria has been influenced, and whether or not there has been any increase in anopheles mosquitoes in the specially unhealthy tracts or during the unhealthy years.

There is, it is true, a way, but an indirect one, in which changes in the great rivers may seriously influence malarial incidence and this has already been well described by Chatterjee, who points out that by the shifting of the river channels to the east, towns and districts once prosperous and flourishing suffer from loss of trade, industries decay, and populations become subject to economic conditions favourable to malaria. But though this has no doubt played its part, it appears insufficient to explain why epidemics have specially prevailed during particular years in certain parts of the country.

Commission after Commission reporting upon the question have invariably dismissed the suggestion that the making of roads and railways was concerned in causing obstruction to the drainage.

A glance at the map of Bengal will show that the districts that have been from time to time involved in epidemic malarial outbreaks bear a certain relationship to Calcutta; that they are practically identical with the great industrial areas to the north and west of the city and the expanding fan of railways that link the metropolis to the great districts on the north-east and north-west. Above all the recurring epidemics have often picked out in a curious manner, parts like the great coal districts of Burdwan, the mill districts of Hooghly, and other centres of industrial activity.

Before hazarding an opinion as to how far this is mere coincidence or real association, let us consider the local history of this part of Bengal. Prior to 1860 there is little evidence of the existence of anything like the movement towards the immense industrial expansion of recent times; but from about this time there commences a period of phenomenal activity in commercial enterprise and an era which saw the inauguration and completion of enormous public works. Within a decade three great canal systems, the great railways, a vast net-

work of roads together with industries like those of coal, jute, cotton and tea sprang into existence and underwent extraordinary development. From 1868 onwards we find the Sone, Orissa and the Midnapore canals undergoing construction, the three schemes being nearly completed in 1881. The year 1871 saw the completion of 2,800 miles of the first general scheme of railways in India linking up most of the important towns and cities, Calcutta among them. Between 1872 and 1881, 525 miles of railway were constructed in Bengal and from 1872 and 1881-91 a further 1,051 miles had been added to this total, which was still further increased by another 1,614 miles of line opened in 1901.

The coal industry, which in 1860 had an output four times as great as that of ten years previously, exported in 1905 from the Bengal coal-fields alone seven and quarter million tons. The jute and cotton industries, which in 1860 were in their infancy, now possess mills scattered throughout the whole of Hooghly and the neighbouring districts, jute mills alone in 1904 possessing nearly 20,000 spindles and employing an average daily labour force of close upon 140,000 persons.

Calcutta, the centre of this new movement, rapidly expanded under the stimulation of increasing commercial activity, which necessitated also the establishment of docks and the extension of harbours, together with the erection of vast blocks of buildings throughout the city and its widening suburbs.

All this expansion has meant LABOUR—labour on the aggregate in vast amount—labour brought together and employed under conditions little different and certainly no better than those that may be met with at the present time whenever and wherever projects of a similar nature to those we have alluded to, require to be carried out. Year after year, now in this district, now in that, innumerable labour camps must have been formed. Along every new railway, every canal, every important road under construction, and around every engineering or building project, or associated with every rapidly developing industry there must have sprung into existence these more or less temporary aggregations of labour with the almost certain consequence

of epidemic malaria similar to that which has occurred at Hong Kong, Panama, and many other places in the tropics. And if we follow, as closely as possible, the course of fever epidemics in those years when they have been widespread and intense we find that they correspond in an extraordinary manner with the times and places in which industrial projects or large public works were being most actively pushed forward.

A special period characterised by the prevalence of epidemic malaria coincident with an expansion in the coal trade and the construction of great public works may be recognised in 1860-74, and another in 1880-81 when, after times of lessened activity, numbers of important and long postponed projects were put in hand, and it is recorded that the expenditure on railways, irrigation works and roads amounted to the sum of 20 crores of rupees within a few years.

As the Presidency became opened up, its railways extended, its canals completed, and its up-country industries developed, the series of malarial epidemics assumed a new phase and Dinajpur and Rungpur, which a glance at the map will show stand at the portals of the tea districts, and Rajshahi, which lies immediately to the south, begin to be conspicuous as the seat of epidemic malaria. Reference to the Census reports will show that there has been no more extensive emigration in India than that which has taken place from the south-western portions of Bengal and part of the adjoining provinces to the tea gardens in the north-east. All the main lines of communication pass through the areas we have mentioned, which are covered with a network of roads and railways pushed forward, especially in Dinajpur and Rungpur, to meet the growing exigencies of the tea and jute industries; for until comparatively recent times vast numbers of emigrants travelled to their destination on foot or at least traversed considerable tracts of country in this way. We have had an opportunity of seeing some portions of this tract, including Dinajpur, and, though we have not been able for want of time to study the conditions closely, we find everywhere growing in the bazars and outskirts of the smaller towns the characteristic little aggregations of immigrant

labour, all concerned indirectly or directly with what we may term expansion.

Quite recently epidemic malaria has attracted considerable attention in Murshidabad town; and in connection with this we quote a newspaper cutting, dated August 1908—

“The mortality from fevers of which statistics are given in the report of the Sanitary Commissioner for Bengal is something almost past belief. Murshidabad among towns was the worst sufferer, the mortality amounting to 46·08 per mille. It is added that this is the third year in succession that this town has been the most fever-stricken. We read :—‘The civil surgeon is strongly of opinion that the newly constructed branch of the Eastern Bengal State Railway has affected the public health’. He says that the Railway Engineering authorities have been guilty as elsewhere of taking absolutely no means of draining the pits and hollows by the side of the embankments, that he is convinced that in such a malarious neighbourhood specially as that of Murshidabad town, this has led to increased unhealthiness and should be remedied.”

It is needless to say that more than borrow-pits and hollows are concerned.

Time and further research must decide whether we have exaggerated the importance of this matter, but if not, it seems to us that this factor in malaria must be recognised and dealt with; for there appears to be every probability that, when allowed to act year after year without attempt at control upon populations whose general health is already in a state of precarious stability, it may so far upset this equilibrium as to produce widespread outbreaks of disease amongst them.

Industrial expansion in the tropics is but beginning; every year its requirements become more urgent; every year it is taking fresh strides; and on the threshold of every advance in India, as well as in every other tropical country, we are met with the necessity for this industrial aggregation of labour.

There is nothing to make us believe that deltaic or other physical conditions are necessary for the occurrence of epidemic malaria, for anopheles mosquitoes exist throughout the country and can everywhere find facilities for continuous breeding; and such being the case we have reason to anticipate that, with each fresh impetus and new direction given to industrial expansion, we shall find, in the absence of proper measures of control, an extension in the geographical distribution of intense malaria and hear of new areas subject to the ravages of the disease in epidemic form.

It may be said that these unfortunate influences, the action and result of which we have indicated in broad outline, are in themselves so vast that they lie beyond the power and scope of human interference and that their recognition will not help us in the war against disease. But although we may not be able to deal with the malaria of a whole province, with a population numbering many millions, many of whom are probably but little affected by the disease, we can deal with malaria among the labourers on a railway, a canal, a coal mine, or a tea garden, in a way that we cannot do with malaria among the more widely scattered populations of great rural areas; and by this means we can prevent the occurrence of, or reduce the liability to, the otherwise inevitable scourge of intensified epidemic malaria, and attain a result that will prove out of all proportion greater than the mere direct effect upon those immediately concerned *for beyond the loss of life and suffering of the actual labourers is the all-important question of the health of large communities which they are liable to infect.*

With the methods to be adopted in malarial prophylaxis we do not here concern ourselves; but if we are dealing with an exaltation of malaria due to the action of factors affecting the human host, where every influence that tends to increase susceptibility is at its height, there are other measures required besides those of specific prophylaxis, measures which, while they incidentally aim at relieving hardship and misery, are directed at a vulnerable point in the development of the most important of all topical diseases.

We cannot ignore such assistance, as we have not yet any reason to believe that anti-larval operations are capable in the least

degree of controlling malaria in the great districts and provinces of India.

Not only have all successful anti-larval campaigns been associated with the free use of quinine, but they have in every case dealt with comparatively insignificant populations, in some cases with communities no larger than those to be found upon a single tea garden; and they have involved comparatively enormous expense reaching in some cases several pounds sterling per head of the population.

It is impossible to argue from such examples the probable effects of large drainage operations or measures directed against the mosquito alone, and we have already shown how small a relation mere numbers of anopheles often bears to the prevalence and intensity of malaria when conditions unfavourable to the human host are present in a marked degree. This being so, it is impossible with our present knowledge to be certain that the inauguration of vast drainage schemes at a cost of crores of rupees will have the slightest appreciable effect in reducing malaria in Bengal; and it is quite possible, on the other hands, that without the most careful control of the conditions relating to the employment of labour on such undertakings grave danger may be incurred, and this very measure far from reducing malaria may, for a time at least, serve actually to increase and intensify it; while the larger the scheme, the greater would be the risk arising from uncontrolled aggregation of the labour necessary for the performance of the work.

As to the repeated statement that drainage of a country must necessarily produce a mitigation of malaria by reducing the numbers of anopheles mosquitoes, we may surmise, bearing in mind Celli's definitely-expressed opinion regarding the Roman Campagna as well as our own experience in India, that the improvement that follows such operations may often be largely secondary in nature and bound up to a great extent with the permanent settling of populations and other conditions favourably affecting the human host.

With the conclusions we have formulated above we see adequate reasons why the Duars should be malarious; and we can see that in attempting to control the malaria it would be a mistake to take too narrow a standpoint in our estimation of the conditions involved.

II.—THE DUARS AND MALARIA.

The Duars, as popularly understood, is a portion of *terai* land stretching for about ninety miles along the foot of the Eastern Himalayas. It extends at most fifteen miles from the foot of the hills and in total area does not exceed a thousand square miles. But in spite of its small extent it is one of the chief of the tea districts, producing more than one-fifth of the tea produced in India. Otherwise this district is of little importance since it possesses no townships and few villages of any size; in fact, but for the land which has been cleared for tea cultivation, it is almost entirely forest and jungle.

In official matters the Duars includes more extensive portions of the *thanas* of Dam Dim, Mainaguri, and Phalakata; but the southern portion of these *thanas*, composed of rich agricultural and thickly populated by Rajbansis and other cultivators, has little in common with the northern or tea-growing portions with which we are concerned.

Scattered throughout the district, but most closely aggregated in the western portions, are the various tea gardens. The gardens, like those of Assam, are large and are worked by various tea companies, only a few small gardens being owned by resident planters.

The gardens number about one hundred. All but about a dozen of these have European managers and from one to four or even more European assistants. In addition each garden employs a certain number of Bengali clerks or other subordinates, and upon each garden (living in lines) is a considerable coolie population. These populations, including men, women and children, are rarely below one thousand in number and on larger gardens consist of from four to six thousand persons.

It is these lines which form the villages, so to speak, of the tract under discussion, and the garden populations which, taken collectively, constitute for all practical purposes the population of the Duars. There are, it is true, a certain number of aboriginal Meehes still living in the Duars, but these have almost disappeared from the western portions and are only found in any number to the east where tea culti-

vation has as yet not claimed so much of the country. Independent colonisation by old tea-garden coolies also exists but the "bustee" population, as it is termed, forms but a small item in comparison with the garden labour.

Malaria is rife throughout the whole coolie population, and the general impression that we have gathered is that it forms the *one* important disease influencing the tea industry in the Duars.

The condition as regards malaria among the aboriginals is interesting, but cannot be considered as forming an important part of the problem to be investigated. The interest attaches chiefly to the question as to whether the Meches being the original inhabitants of the country suffer from fever to the same extent as the immigrants. Briefly we may say that to a large extent they do. But the Duars being malarious, apparently not so much because of its physical features as by reason of the state of affairs brought about by the opening up of the country, one must look upon the aboriginal Mech as now quite as much a stranger to the existing intense malaria as any immigrant. The condition in the independent "bustee" colonised by old tea-garden coolies we shall refer to later.

ESTIMATION OF THE AMOUNT OF MALARIA.

Since there are no hospitals, and the cases of sickness recorded on the gardens do not, as we shall show, bear any real relation to the amount of malarial disease, we are confined, if we wish to estimate the amount of malaria, to such general methods of estimation as—

- (a) The endemic index and the spleen-rate.
- (b) The amount of infection and the degree to which enlarged spleen prevails among the adult population.
- (c) The effects of malaria as shown by the amount of sickness and death and the general effect of the disease upon the community.

The endemic index and spleen-rate.—The percentage of infected children was shown in 1901, on those gardens visited by the Royal

Society's Commission to be more or less uniformly high. We have extended these observations to a considerable proportion of the total gardens and have found that the amount of infection noted can be stated to vary very little throughout the Duars. In a large number of estimations involving the examination of many hundred of children we have only twice found the endemic index below 50 per cent., and in the vast majority of cases it approximated very closely to 100 per cent. The spleen-rate has never been less than the endemic index. These points will be demonstrated by the tabular statements of our results given in Appendix I. Specially noteworthy is the maintenance of this high rate of infection through some seven months of the dry season and its presence on a number of gardens so situated as to appear extremely unfavourable to the existence of even a moderate amount of malaria.

Race appears to play but little part in influencing the prevalence of infection, though some races appear to be more profoundly affected by the disease than other. In several instances where we have examined the children of hill and plains people living on the same garden under similar conditions, but with the two races widely separated, we have found the rate of infection and of enlarged spleen to be practically the same in each case. As a general rule, however, more actual sickness due to this disease is seen among the hill people than, for example, among natives of the Ranchee and Hazaribagh districts.

Adult malaria.—Malarial infection in the Duars is not confined to the children, but affects profoundly a considerable proportion of the adults. This is especially so in the case of new coolies, most of whom come from comparatively non-malarious districts and are quite differently circumstanced as regards malaria to indigenous adults in a malarious country, who have been immunised to malaria during childhood. The extent to which adult in the Duars suffer from the disease will be gathered from facts given in the chapter on "Sickness in the Duars."

VARIETIES OF THE PARASITE.

All three forms of the parasite, quartan, simple tertian and malignant tertian, are almost equally common, though simple tertian infections slightly preponderate.

A certain amount of variation occurs in the seasonal distribution of the different species. On the lower gardens in the rains infection with the malignant tertian parasite becomes prominent; but as the dry weather advances this parasite tends to become less conspicuous and towards the end of the dry and cold season quartan infections predominate. Very often we have been struck with the existence of groups of infections by one or other variety, a condition particularly noticeable in the case of quartan forms.

Mixed infections are exceedingly common if not the rule; though generally at the time of examination parasites of one or other species are in the majority.

HOW MALARIA SHOWS ITSELF.

Malaria in a native population does not confine itself to causing attacks of "fever", and a due appreciation of its effects under such circumstances is very necessary.

Child malaria.—Very young children are usually fat and healthy, with normal blood free from parasites. They soon, however, begin to get serious attacks of fever, and, at an age of from six months to two years, it is very doubtful if one child in many hundreds will be found whose blood is not more or less thin and watery and whose whole physique is not modified by malaria. Whatever intercurrent disease or symptoms such children may eventually exhibit, it is certain that malaria is the primary cause at work in bringing about their death. In some instances seen by us malaria seems responsible for the almost complete absence of children among certain communities, nearly every child dying within a year or two of its birth.

Coolie anæmia.—Though adult coolies shortly after they first enter the district may be found exhibiting the typical clinical symptoms of acute malaria, they soon present an entirely different picture in which "fever" is subordinated to intense anæmia. Such anæmia is apt to suggest anchylostomiasis, but in the Duars it is nearly always malarial in origin.

Dysentery.—Most adults dying from malaria exhibit the most intense anæmia, œdema of the face and ankles or more or less general dropsy and a form of terminal dysentery. Dysentery in such a connection cannot rightly be considered as the real cause of death, though it is frequently returned as such.

Abortion.—Pregnant women are particularly liable to abort as a result of acute attacks of fever or as the result of the intensely anæmic condition that we have described. In the latter case large numbers of women abort or die before or immediately after childbirth, and even when the child is born at full time it is small and ill-developed, and very frequently it is beyond the powers of the mother to nourish it. The extraordinary number of abortions under such conditions has given rise to the impression that criminal abortion is frequent, an idea but little supported by actual observation.

General apathy.—We have not infrequently heard it said that “laziness” is responsible for many coolies not working and that this in turn makes them sick and anæmic. This is an inversion of the real facts. A marked feature of the chronic malarial subject is a characteristic apathy, and it is easy to understand that when, as is very frequently the case, the percentage of hæmoglobin falls to below 25 per cent. of the normal the subject becomes apathetic, unwilling to work, and there commences the vicious cycle that often ends in death.

General unrest and movement of the population.—Where, as in the Duars, malaria is intense, family bereavement and constant ill-health, interference with means of livelihood and resulting hardship to dependents, together with a host of other effects resulting indirectly from the same cause lead to a constant state of shifting in the population. Movement from garden to garden in the Duars is extraordinarily frequent and seems to be due to a state of unrest produced by a want of the sense of well-being.

THE EFFECTS OF MALARIA.

In the Duars we see exemplified all the effects of intense malaria. These may be briefly summarised :—

- (a) An abnormally high death-rate and a diminished birth-rate, not only preventing the natural increase of the population,

but causing an actual decrease hidden only by constant immigration. (*Vide* Chapter VIII, Vital Statistics.)

- (b) Difficulty in getting sufficient labour; restriction of the necessary recruitment of labour to areas inhabited by specially hardy races; excessive recruiting to keep up the labour force; and poor efficiency even of the labour force maintained.
- (c) A very small degree of true colonisation and the general persistence of temporary conditions.
- (d) General backwardness of the district, due to sickness and death among Europeans and their Bengali staff; avoidance of the area by all who are not forced to enter it; interference with all branches of the public service as well as of private enterprise owing to sickness, and difficulty in maintaining a good class of subordinate, and other conditions which hinder progress.

GENERAL CHARACTER OF THE PREVALENCE OF MALARIA IN THE DUARS.

The state of exalted malaria which we have described resembles a permanent condition of epidemic malaria. Such a condition we may for convenience term **HYPER ENDEMICITY**.

III.—ANOPHELES IN THE DUARS.

Anopheles are very prevalent in the Duars during the rains and for some months after. Their breeding places are chiefly connected with the small streams so characteristic of the district. These streams are remarkable for the extreme variation they undergo at different seasons of the year, and as a result of continuous rain, floods, and changes in their beds. Most of the streams, especially those in the northern portion of the district, flow upon beds of roughly tumbled boulders. In the rains they become torrents; but in the dry season they rapidly shrink to trickling rivulets or chains of small pools, eventually in the majority of instances becoming entirely dry. Owing to the porous nature of their beds they may be found sometimes with running water in one part of their course and long dry portions at another. The stream beds are often several hundred yards in width; or where an old deserted channel of one of the larger streams is concerned, they may be half a mile or more wide with tumbled boulders, jungle and a net-work of rills fed from innumerable springs. In many of the tea gardens the streams run in a sinuous manner at the bottom of deep precipitous ravines filled with more or less dense jungle. In the low-lying tracts the streams possess muddy or sandy bottoms and sedgy edges, while the current is more sluggish; and streams of this nature generally persist throughout the dry season. In a few gardens there are almost stagnant perennial water-courses of considerable depth winding through the land.

Where lines of springs issue or where there are many deserted river channels small swamps are common. The more extensive of these are often used for rice cultivation; but many are filled with rank vegetation and jungle. One or many small streams usually flow through them, and these invariably contain the larvæ of *M. listoni*, *N. theobaldi* and other species.

Other breeding places of very varied nature also exist, the most important being rice-fields, large pools, borrow-pits and *kutchā* wells. Garden drains also often form breeding places. None of these, however, are so important as regards breeding of anopheles as the streams and swamps that we have mentioned as being so characteristic of the district.

SEASONAL VARIATION IN THE BREEDING PLACES OF ANOPHELES.

Early in the year until the rains begin to fall in May or June, breeding places are scanty and widely separated. All the smaller streams are dry and many of the larger ones contain but little water. At this time large areas are absolutely devoid of surface water of any kind. The first showers of rain have no appreciable effect, sinking rapidly into the dry and porous soil, and though several inches of rainfall may be recorded, the streams do not run, nor are any permanent surface pools formed. But as the rains continue the streams begin to flow in certain parts of their course and eventually with every succeeding downpour they become swollen torrent; and in the case of gardens situated on low-lying ground more or less temporary pools and swamps are formed. At the height of the rains many of the torrents show no anopheles larvæ; but these are to be found in small collections of water of a temporary nature that occur in the grass and jungle, or even in little streams and drains which run intermittently and for the briefest period.

After the cessation of the rains during the months of September, throughout October, and to a less extent during November and December, the streams fed by springs and the general soakage from their beds become throughout most of their course stocked with the larvæ of anopheles. By the end of December and the beginning of January the smaller streams are dry or show only occasional small pools here and there, or perhaps a few trickling springs, the condition we have described results, and for considerable distances there are no anopheles larvæ to be found anywhere.

SPECIES OF ANOPHELES.

The common species of anopheles are *M. listoni*, *N. theobaldi* and *P. rossi*. The last species is fairly abundant in some places where suitable breeding places occur; but it is not nearly so conspicuous in the Duars as in many parts of India. *M. barbirostris* is found in great abundance in a few places; but is not widespread, or common in the district. *N. fuliginosis* and *A. elegans* also occur, but not to any great extent. *A. sinensis* is exceedingly common at Jalpaiguri town, but rare in the Duars. *M. culicifacies*, the common

malarial carrier of the Punjab, is also rare. *N. stephensi*, a common Indian species, has never been found by us in the Duars.

Myzomyia listoni.—This is the most important species present, and the one most frequently met with in dwellings. Its larvæ are especially abundant in running water, especially in the little boulder-strewn streams where water continues to trickle for some time after the cessation of the rains. They are found congregated in the shelter of boulders, or lying in little pools and nooks at the edges of the bank, and in the largest numbers where a few blades of grass project into the water. They may be found also along the edges of streams of considerable volume, even where there is no grassy or weedy growth to shelter them, in quiet portions where the current is broken by the presence of large boulders. Very often they occur in large numbers among the pebbles where the water is in such small amounts that it cannot be dipped out until a small pool has been formed by the removal of a few stones.

The adults can travel considerable distances and can rise several hundred feet. High bluffs overlooking swampy country are often infested with this species. They can exist through many months of drought and may be found when it is difficult to determine the breeding places from which they have originated.

Nyssorhynchus theobaldi.—Like *M. listoni* this species is also a stream-breeder, but its larvæ are found most frequently in the small pools left during the drying up of the stream beds after the rains. Like the larvæ of *M. listoni* its larvæ, especially the larger ones, may, when disturbed, sink to the bottom of the water and remain there for long periods. We have frequently obtained thirty or more specimens from a small pool a foot or so square by stirring up the bottom and then waiting patiently for them to appear; in such cases an ordinary cursory examination might have led us to conclude that no larvæ were present.

The adult is a strong flier and may be found in dwellings far from its breeding places.

Pseudomyzomia rossi.—This species breeds in the Duars in buffalo wallows, rice-fields, and small surface pools on roads and in lines.

The adults exhibit considerable powers of passing through long periods of drought.

Mysorhynchus barbirostris.—Is found breeding in grassy pools and drains. In one case the larvæ of this species were seen in profusion in some foul water in a tea-house drain along with the larvæ of *P. rossi*.

The adults do not appear to fly to any great distance, as will be seen in the section on flight. The adults also disappear very quickly after the drying up of their breeding places.

Nyssorhynchus fuliginosus.—Is found in some parts of the district where there are larger pools of weed-covered water, but never in very large numbers.

FLIGHT OF ANOPHELES.

Very often in the Duars we have found anopheles in considerable numbers in spite of the fact that the nearest breeding places were a considerable distance away. Houses and lines on high bluffs, for example, are almost invariably infested with anopheles, though breeding places in such cases are nearly always several hundred yards away. It seems certain that *M. listoni* and *N. theobaldi* habitually traverse distances up to a quarter of a mile, and in the case of *N. theobaldi* we have seen an instance where it seems certain that adults were traversing nearly double this distance to reach a bungalow on a steep bluff.

It has often been taken for granted that the flight of anopheles is a "random" one, but all evidence is in favour of its being purposive. That anopheles exercise very intelligent action in attempting to gain an entrance to rooms and mosquito-nets is very evident to one who notes their behaviour when frustrated; and their attraction by light often in very large numbers has been demonstrated by us on several occasions. It is not at all surprising then that they should direct their flight purposely towards light and sounds in a bungalow, line, or bazaar, rather than be dependent on random

flight to take them to their food. Whilst then a house on a bluff, or a line on an exposed area of ground, may cause anopheles to find their way considerable distances, it does not follow that they will, without obvious reasons, be always found at such a distance from the breeding place.

It also cannot be assumed that an anopheles covers the whole distance in a single flight or in a single night. A ship lying off a harbour seems at first sight an excellent test of the power of flight of mosquitoes, but it is in reality no test of the distance that anopheles will penetrate an area free from breeding places on land. The question of flight and penetration are very important. Very often breeding places exist a few hundred feet from where adult anopheles are to be found in dwellings; but it does not always follow that these are the main sources whence they come. Experience has shown us that the abolition of such breeding places often does not at all influence the prevalence of the adults. An illustration of this was seen by us at a garden called Mean Glas in the Duars. In this garden the Manager had greatly interested himself in a systematic attempt at petrolage of the breeding places around his bungalow and certain of his coolie lines. From May onwards systematic petrolage was carried out round the bungalow to a distance of quarter-mile radius. In August one of us examined the treated area, but after a careful search found only a few very young and half-grown larvæ, though just beyond the limits of the area were drains with numerous full-grown anopheles larvæ and nymphs.

Nevertheless in the bungalow adult *M. listoni* and *N. theobaldi* were abundant and could be seen at night and in the very early morning endeavouring to enter through the screens of wire gauze, with which the bungalow was in the process of being protected.

After our visit Mr. Wallich extended his operations to a half-mile radius and when we visited him during the first week in November the absence of larvæ in the treated areas was very striking, nevertheless adult anopheles were still to be caught in the bungalow.

The experiment also suggested that different species behave differently in respect of the distances they travel. Most of the drains at Mean Glas just beyond the area of operations contained larvæ of *M. listoni* and *N. theobaldi*; but one stagnant drain contained considerable numbers of the larvæ of *M. barbirostris* and *A. aitkeni*.

Only very few specimens, however, of the adults of these two latter species were caught, two of the one and three of the other being seen in the course of ten days.

In many instances we found anopheles mosquitoes in dwellings, although it was impossible to find any breeding places except at a great distance; whether in any particular instance this is the result of flight or of a condition to which we shall now refer is often very difficult to determine.

RESIDUAL ANOPHELES.

Apart from an allowance for flight and penetration there is another condition which requires mention. When extensive breeding places dry up adult anopheles are very frequently found, often in considerable numbers, for weeks or even months afterwards.

The condition in which adults are present in the absence of breeding places we shall call one of residual anopheles. This is a very common condition, and is important, since not to recognise it may lead to considerable error in estimating the nature, means and extent of prophylactic measures required.

Where a number of breeding places have dried up it is easy to explain residual anopheles; but residual anopheles may be found where the only explanation of their presence seems to be that under certain conditions very suitable for the adults these make use of the most temporary means of breeding to maintain their numbers. A very paradoxical condition, which we can only explain on this hypothesis, was found by us in certain gardens in the Dina-Torsa district situated on peculiar, porous, alluvial slopes, uninterrupted for very long distances by permanent streams or ravines. In this area the ground is so porous that the heaviest rain only serves to create very temporary freshets which cease to flow and are more or less completely absorbed within a few hours. Many streams indeed,

which during the heavy rain sweep through the upper portion of the district, never reach the lower part, the water being completely absorbed. In the gardens referred to the water supply is a difficult problem, water having to be brought several miles in pipe lines from the hills or obtained from deep wells sunk to a depth of from sixty to ninety feet. At Gundarpara, one of these gardens, we found anopheles in small numbers in the bungalow, but we failed to find any source of these insects; at most of the other gardens in the same area similar conditions existed. At Hantapara we caught *M. listoni*, *N. theobaldi* and *P. rossi*; yet the only breeding places to be found were a few small pools of waste water from taps, in which a very few larvæ of *P. rossi* were found. During the height of the rains we found, however, at a considerable distance a swampy freshet and at one end of the very extensive lines a few pools of dirty water suitable for the breeding of *P. rossi*. It may be suggested that in these cases anopheles have been breeding in the hollows of large-leaved plants; but in the Duars we have been unable to find larvæ in such situations and the species found were the stream breeding *M. listoni* and puddle-breeding *P. rossi*. At Binaguri, Lankapara, and Bandapani the same extraordinary conditions occurred. It is of course possible that importation may be partly responsible for these seemingly extraordinary results; but the condition of residual anopheles, whatever be the explanation of its occurrence in its different places, is an important feature of the epidemiology of malaria in the Duars. It prevails throughout the greater portion of the Duars when, as a result of drought—a circumstance of constant occurrence during many months of the year—breeding places have become very greatly reduced in numbers; and it serves to keep supplied with anopheles aggregations of human beings, however favourably they may be situated.

RESIDUAL MALARIA.

In the Duars some of the gardens are on comparatively high land, some on land that can be described as almost waterless; others on ground intersected in every direction with streams, and abounding in springs and swampy places. The conditions as regards facilities for the breeding of anopheles therefore vary very greatly

But in regard to malaria the drier gardens show but a slightly lower rate of malarial infection and perhaps a lesser tendency for Europeans to contract the disease than those intersected by innumerable streams and swamps. For all practical purposes the native malaria and especially the endemic index is the same throughout the whole district whatever the physical conditions may be. Again for some seven months of the year there is a steady reduction in breeding places which by January have in many places almost or entirely disappeared, and a great reduction in the number of adult anopheles. Yet at no time of the year is there any marked reduction of the endemic index. For example, the northern end of a particular line was during the dry weather at least a mile from the nearest water. Yet the endemic index after this condition had existed for some months was still 67 per cent. The prevalence of malaria at a time when anopheles are greatly reduced and their breeding places abolished reaches its acme on those gardens to which we have already referred as situated on the peculiar tract of sloping porous land in the Dina-Torsa district. These gardens to judge from their apparent unsuitability for anopheles, should have been almost free from malaria; as a matter of fact they are not so. At one of them, on the contrary, we found in April, May and August as remarkable an intensity of malaria as at any place we have visited. Not only were the endemic index and the spleen rate extremely high, but we saw an amount of sickness and misery the result of Malaria nothing short of astonishing in the circumstances. Clearly some very definite condition was involved enabling malaria thus to maintain itself under circumstances so apparently unsuitable for its spread. We believe this condition to be the fact that in certain conditions the amount of human infection may remain undiminished owing to the suitability of the host to the continuance of infection for long periods, and thus a minimum number of anopheles serve to keep up a maximum amount of infection.

We have referred to this condition in the introduction as "residual malaria" and in conditions tending to make communities suitable for such a state we seem to have at work some of the most potent factors in the causation of hyper-endemicity.

If x anopheles be sufficient to cause 100 per cent. of infection; then x anopheles, it is obvious, cannot further increase the mischief; but we have no data as to the figure x in different conditions. Our own experience seems to point to its being in the Duars at any rate very small, so small that the probable success of human efforts to reduce anopheles to below this figure does not seem very great in this district.

This aspect of affairs has not apparently been recognised in numerous instances where the malaria of a community has been judged as necessarily directly proportionate to the number of anopheles present, and where it has been supposed that a partial reduction of anopheles was in itself bound to influence malaria to an appreciable extent in any given community.

The general nature of the causes bringing about residual malaria we have already indicated in the introduction, and since these causes seem in the Duars at once most concerned and most controllable they are those upon which we shall have to lay most stress.

IV.—IMMIGRATION.

The coolie population on the tea gardens of the Duars, which roughly-speaking numbers 150,000 persons, is almost entirely immigrant in character; not only so, but it has all been recruited during the past thirty years. The districts from which it has been mainly drawn are—

(a) The various districts of Chota Nagpur and the Santal Pargannas.

(b) Nepal and the Darjeeling Hills.

The races concerned are chiefly the so-called Chota Nagpuri, Kols, Santals, and Nepalese.

In the absence of the registration the number of persons entering the Duars every year can only be very roughly computed.

Even the numbers recorded on the different garden books represent only actual labourers. In our experience at least twenty-five per cent. has to be allowed in the case of Chota Nagpuri and Santali labour for young children and dependants. The number of immigrant adult labourers alone, not including children and dependants entering the tea-gardens from Bengal, appears to be not less than 7,000 to 8,000 per annum, and we have been informed that during the year 1907-08 the total number recruited by all gardens in the Duars probably reached a total of 20,000.

Regarding the yearly immigration into the Duars from the Darjeeling hills and Nepal, we have absolutely no data and any estimation is rendered very difficult by the fact that, in addition to the large numbers of Paharia coolies, who yearly enter the Duars with the intention of remaining one or more seasons, numberless gangs of labourers come down every year from the hills in order to find employment during the cold weather months, returning again to the hills on the approach of the rainy season. But approximately there would seem to be about half as many semi-permanently settled Nepalese and Paharias as people from the plains and, allowing for dependants and children, total yearly immigration of these classes

must number annually some 4,000 to 5,000 persons exclusive of the cold weather labourers.

The total yearly immigration to the tea gardens from the hills and plains together cannot, we believe, be less than 12,000 persons ; and in some years it is probably very greatly in excess of this number. Thus in 1907-08, in coolie lines examined by us with a view to ascertaining the proportion of new coolies, we found these to form between ten to fifty per cent of the whole and an average of twenty-five per cent. of the whole seemed to be very general throughout the district. This would give the extraordinarily high figure of an annual influx of over 30,000 persons—men, women and children—which is, we believe, nearer the truth than our minimum calculation.

These figure assume great significance when we remember that the Duars is by no means a very large tract. And, when we compare the annual influx into Assam, it is at once apparent that immigration into the tea gardens of the Duars, which totals some 80,000 acres under tea, is at present relatively greatly in excess of that into the tea districts of Assam which has an area under tea four times as great.

It is necessary to follow out in some detail the actual conditions associated with this annual influx of strangers.

CONDITION OF NEW ARRIVALS AS REGARDS MALARIA.

Examination of coolies entering the Duars shows that the great majority are free from malaria. This point is well illustrated in the following examples :—

Among 60 adults 14 children and 5 infants who had come up from part of Chota Nagpur not one had an enlarged spleen, nor did the examination of their blood show parasites. The blood of the babies and children also was normal and offered a remarkable contrast to that of children of a similar age resident some time in the Duars.

Among three hundred coolies recruited in a single year from the Santal pargannas and Singhbhum, examination of the

young children between the ages of 2 and 9 years yielded the following results :—

		per cent.
(1) Children, old residents	{ 18 with enlarged spleen 3 with no enlargement }	86
(2) Children resident in the Duars 3 months.	{ 2 with enlarged spleen 1 without enlarged spleen }	67
(3) Children resident only 2 months.	{ 7 with enlarged spleen 8 without enlarged spleen }	47
(4) Children resident only one month.	{ 5 with enlarged spleen 0 without enlarged spleen }	33
(5) Children day of arrival	{ 0 with enlarged spleen 11 without enlarged spleen }	0

In a small line of Chota Nagpuri coolies, 25 children were examined and 16 were found to have enlarged spleens, while 9 showed no enlargement. Enquiry showed that every one of the latter were recent arrivals from their country. Out of another large batch of new children, 29 in number, who had come with their parents from Chibassa less than a month previously, only 2 had splenic enlargement. Among 46 others, resident about 3 months, 22 showed enlarged spleen, while 24 new children, resident 5 or 6 months, every one showed splenic enlargement.

Of 9 coolies from Chota Nagpur up a few days, 2 showed slight enlarged spleen. Of 29 coolies from Kuru (Ranehi) only 2 showed enlargement of the spleen. But among 15 coolies from the same district up one to two months 8 showed splenic enlargement; and among 369 adult natives examined in the Duars without reference to their length of residence, 257 showed splenic enlargement.

These figures indicate that to the vast majority of immigrants entering the Duars the conditions there present as regards malaria are quite new and totally different to what they have been accustomed to in their own homes.

Occasionally, however, a batch of coolies may show the presence of a good deal of malaria, having evidently come from some locality or community where malaria was very prevalent. For example :—

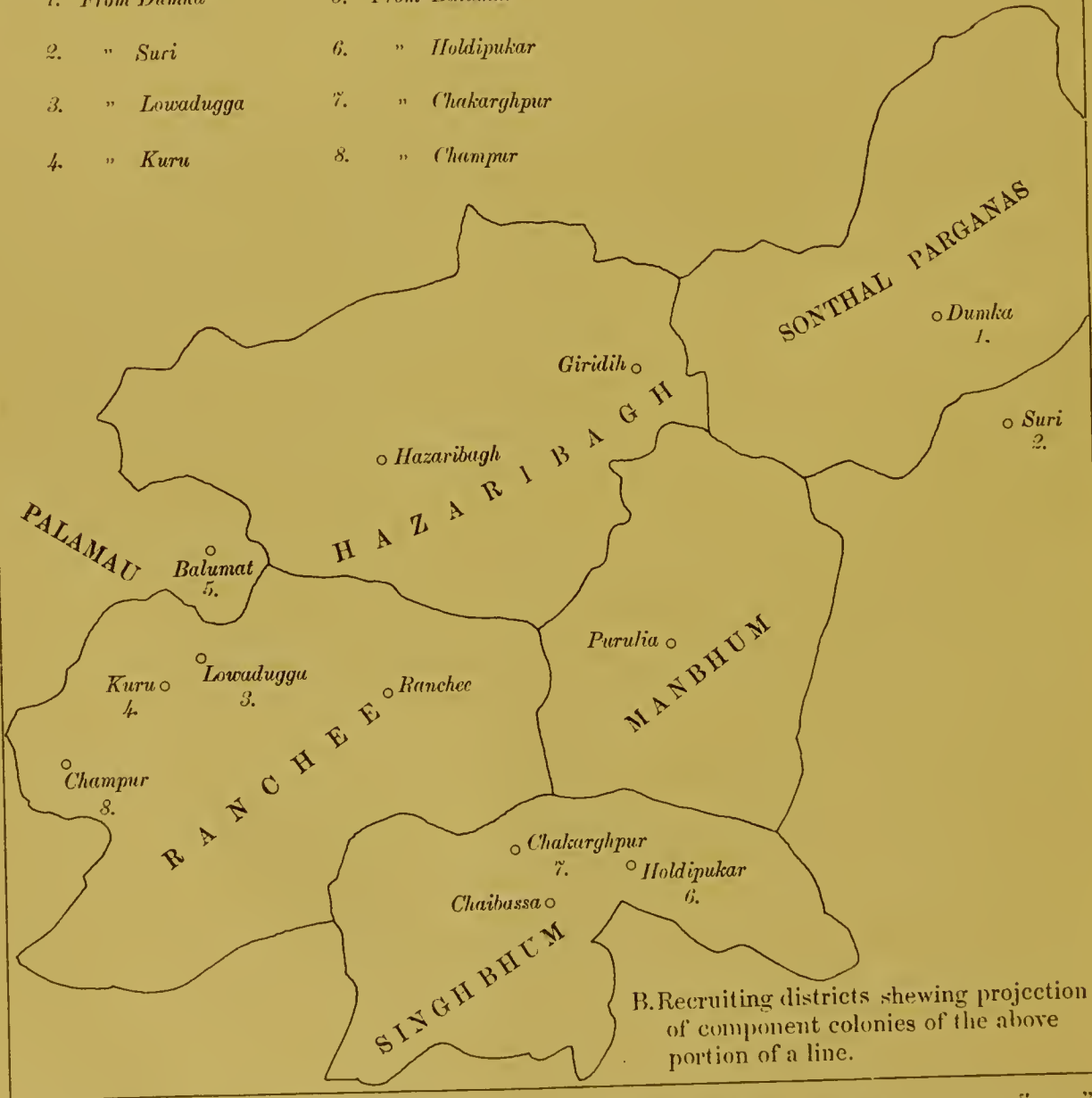
Among 12 coolies from Lahardugga, workers in ironstone excavations in the hills, 11 showed enlargement of the spleen when seen on the day of their arrival in the Duars.



A. Plan of a small portion of a coolie line.

Colonies

- | | |
|----------------|------------------|
| 1. From Dumka | 5. From Balumat |
| 2. " Suri | 6. " Holdipukar |
| 3. " Lowadugga | 7. " Chakarghpur |
| 4. " Kuru | 8. " Champur |



B. Recruiting districts shewing projection of component colonies of the above portion of a line.

To illustrate the formation of "colonies" from various districts and the composite nature of "lines"

MIXTURE OF DIFFERENT RACES AND PEOPLE FROM VARIOUS LOCALITIES.

Under the Duars *sardari* system, a *sardar* or his deputy, year after year, visits the recruiting district and returns with a number of new coolies. These coolies are in the majority of cases recruited from some group of villages with which the recruiter is familiar and has some personal connection. On their arrival on the garden, the new coolies settle down in close proximity to coolies that have been brought up in former years by the same *sardar*, for the reasons that—

- (a) They belong to the same *sardar* and work in his gang.
- (b) They get houses given to them in his particular line.
- (c) They usually find themselves among people from their own locality.

It thus comes about that garden lines, which to casual inspection seem to be mere collections of huts, are in reality composed of separate colonies, each one recruited from some particular group of villages or localities.

Some idea of the wide range from which the component colonies of a line are drawn and the resulting mixture of peoples will be gathered from the accompanying plan of a small portion of a line, and the projection on the map of the recruiting districts of the source of the various colonies composing it.

Most of the recruiting localities, if we may judge by the coolies coming from them to the Duars, are comparatively healthy; others are more or less malarious, and some even apparently intensely so. Thus in the Duars malaria carriers from malarious districts and susceptible people from healthy areas are mingled; and, in the presence of anopheles, we have ready the constituents for an explosion of epidemic malaria.

The actual conditions as they now exist are, however, even more favourable to malaria as will be seen in the next section.

MIXTURE OF NEW AND OLD COOLIES.

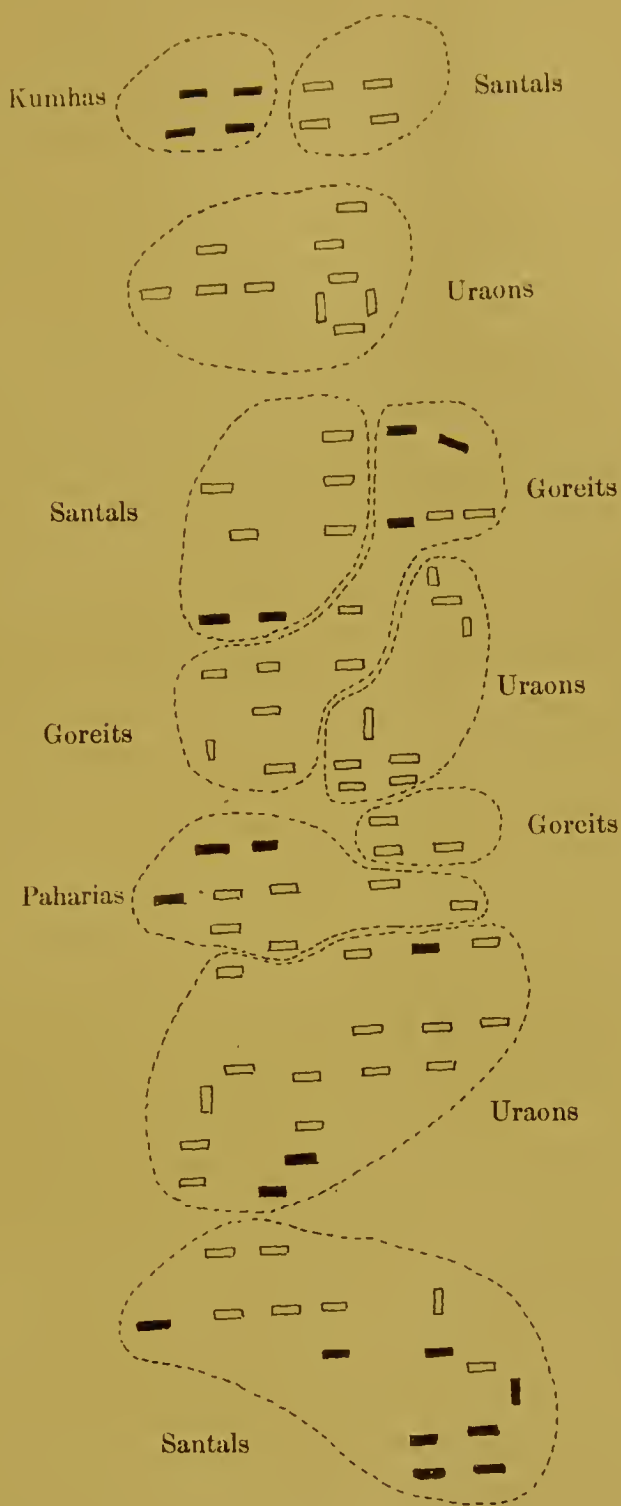
It is evident that each year every colony in every line throughout the Duars is liable to receive its annual addition of new arrivals. Hence new-comers are at once distributed throughout the whole community. An example of this is shown in the accompanying plan of a line taken at the end of the recruiting season.

In the year or two following their arrival these new-comers are in the position of being susceptibles received into a hot bed of infection. They at once become infected, and in proportion to their susceptibility become disseminators of infection. They thus tend to raise still higher the intensity of malaria in the lines. This process repeated year by year tends to maintain a permanent condition of exalted epidemic malaria.

In addition to the mixture produced in the ways we have described there is also a great tendency, for reasons which we need not here specify, for large numbers of the population to move about from garden to garden.

Under conditions where the mingling of infected persons and susceptibles was less complete we might expect that the health of each community would depend upon its relatively healthy or unhealthy situation, and its history and constitution; but in the Duars the conditions suitable for the spread of infection approximate everywhere so much to the optimum that, provided there are any anopheles at all, a state of maximum infection seems everywhere to result.

If under these conditions we wish to reduce disease, it is obvious that we have to think about trying to protect or render the community unsuitable to malaria, especially the new-comers. For, given a moderate degree of infection, the older and more or less immune coolies will manage to retain their health; it is the new coolies, those within the first few years of their arrival, who form as it were the most inflammable fuel, and not only suffer themselves, but raise the amount of prevailing infection for old and new alike.



New Coolies 
Old Coolies 

Portion of a coolie line at the end of the recruiting season shewing the settlement of new coolies among the older residents.

To illustrate Non-Immune Immigration.

Yet in the next few chapters we shall see that it is just this portion of the population which bears the brunt of the conditions we are about to describe.

EFFECT UPON THE RECRUITING DISTRICTS.

Coolies from the Duars in a certain proportion of cases return for a time or permanently to their own country. Practically every such coolie is in greater or less degree an infected person. Where any group of fairly healthy villages is exposed to the constant influx of infected persons they run the danger of becoming foci of epidemic malaria.

V—DUARS' LABOUR SYSTEM.

The first tea gardens established in India were those in Assam and Cachar. These were at first worked by local labour ; but as far back as 1859 local labour was found to be insufficient, and the rapid extension of the industry in these districts led to the recruitment of labour from other parts of India. This recruitment carried on under no legal or sanitary restrictions led to many abuses, and the morality on the journey to and at the gardens became too great to be overlooked. In 1861 a committee was appointed by Government to enquire into the system under which the emigration of coolies to Assam, including the Surma and Brahmaputra valleys, was conducted. As a result of this enquiry and subsequent events, various Acts have been passed at different times regulating the recruitment of coolies and insisting upon sanitary and other provisions in regard to their treatment on the journey and while living on the gardens.

For a long time the only important centre of the industry outside Assam was in the Darjeeling hills, and in this case the influx of local labour from Nepal and Sikkim afforded an ample supply of workers. But the opening of the gardens in the Darjeeling *terai* and later the extension of the industry to the Duars, a tract ceded to the British after the Bhutan war, led to the demand for immigrant labour on an increasing scale for these districts also ; especially has the Duars with its great extent of virgin soil offered a new and rich field for the exploitation of tea and the consequent importation of labour.

But in the Duars the regulations applying to Assam have never been enforced, and the recruitment of labour has gone on under what is known as the "voluntary" or "*sardari*" system, which, since it entails no legal binding of the coolie, is generally considered as not necessitating measures for his protection. Whilst then the Duars has advanced to a foremost place among the tea districts, it has become above and beyond this an example of the working of the special system of labour peculiar to itself ; for we shall see the "voluntary" system in the Duars differs in one important respect at least from the so-called "*sardari*" system known in Assam.

The chief characteristics of this system, the fount and origin of the conditions in the Duars as they now exist, must be clearly understood if we are to grasp the most fundamental factors at work in bringing about the notorious unhealthiness of this area. Perhaps the most important feature is that whilst in Assam there are regulations regarding the protection of the coolie and a system of Government inspection of gardens, in the Duars there is neither the one nor the other ; and did Government inspection exist there would appear to be no powers under which any measure of sanitation could be enforced. Another important feature is that in the Duars there is no system of compulsory registration. A coolie who has entered the district is on the business books of the garden only so long as he is an actual worker whose earnings have to be calculated and from whom advances have to be recovered. Since the labour force forms only a fraction of the total coolie population on a garden, a large number of the latter are not registered in any way and their sickness or death entails no responsibility upon anyone. A coolie on his arrival at the garden is given a house or the materials with which to build one, but there is no actual obligation regarding this, nor is there any recognised standard of accommodation to which he is entitled. As with house accommodation so with water-supply, in the majority of instances the coolie is left to select his own source of supply from the nearest spring or stream, or from wells which would not be passed by any sanitary authority.

In regard to food supply the coolie again is left to make his own arrangements, no matter what the state of the local market may be ; and though in a few cases at certain seasons a manager may purchase rice and supply it to the coolies at cost price, this seems to be a very limited concession affecting only coolies of assured position. Where the jungle is not available for fuel, firewood is often supplied to the coolies at a fixed rate, but again as a rule this chiefly affects people of good standing among the labour force.

A very striking feature of the Duars labour system is the lack of any provision to ensure that coolies when sick shall receive, as they must under the Assam Labour Immigration Act, the means of subsistence, and there is no arrangement to prevent sick and needy coolies suffering from extreme hardship or even actual starvation.

There is an universal belief that when coolies become sick they are fed and looked after by their *sardar*, a belief that has received expression in Mr. Arbuthnott's Report in 1904, and again in the Proceedings of the Assam Labour Enquiry Committee, who visited the Duars in 1906 (*vide* page 126).

“When coolies get sick the *sardar* sees that they are fed and looked after until they recover; beyond the cost of medicines and medical attendance the garden is put to no expense in dieting sick coolies”.

That such a statement can have been made shows that the real conditions are unrecognised. The relation between the *sardar* and his coolies are upon a much less philanthropic footing, as will be seen later, and there is no reason to believe that in the Duars, where sickness is a constant occurrence and a very serious item in the life of a labourer, arrangements can be with advantage left to the *sardar*. No doubt cases of hardship that come to the notice of the manager are relieved; but here again the planter in the Duars is, under the existing system, rarely brought into such close personal contact with the bulk of his coolies as to make such incidents more than occasional acts of charity. There is an attempt at giving medicine to sick coolies; but by no possible pretence, as we shall see later, can the existing arrangements for treating sickness in the Duars be called even reasonably adequate. There is no hospital in the district; and the so-called dispensaries, which are little more than mere stores of drugs, in the absence of proper medical arrangements, for the most part serve inefficiently the purpose for which they are intended. Arrangements for medical supervision are, as we shall see, hopelessly inadequate; and the doctor babus to whom the treatment of many hundreds or thousands of coolies on a garden is relegated are in the great majority of cases unqualified, ignorant and incompetent.

We have not heard of the establishment in any part of the district of an institution in the nature of a coolie *serai* or any arrangements for supplying suitable diet to the sick or providing necessary food to the needy; and no one appears to think such a thing necessary,

In no respect is the absence of responsibility shown more clearly than in the method of registration of births and deaths. Without fear of exaggeration we may say that the return of even approximately accurate figures is nowhere seriously attempted. The whole matter is usually left entirely to the so-called doctor babu, who does not recognise the value of accuracy in these matters and whose returns are rarely supervised. Too often, indeed, these men, to whose incompetency we shall refer later, are convinced that it is against their own interests to report the occurrence of more deaths than they can possibly avoid reporting : and in our own experience " doctor babus " have actually given reasons why they should not do so.

Another prevalent source of error is due to the general custom of removing from the labour roll the names of any coolies who from sickness or other cause have not appeared at work for a clear month. Such coolies may still be resident in the garden lines, many cases of chronic and long-continued sickness falling under this category, but they are to a large extent lost to sight and it frequently happens that deaths occurring amongst them fail to be recorded.

The effect of such loose methods of registration will become apparent in the chapter on vital statistics. It is only necessary to state here that the absence of responsibility in this respect is so amazing that we believe that it would be quite possible for a thousand newly imported coolies, distributed as they are throughout the district, to die within a year without anyone being the wiser.

We have previously referred to the general view that where there is no legal binding of the coolie there is no occasion to provide any kind of protection, the supposition being that even sanitation and other precautions will adjust themselves in these circumstances.

It will be instructive to see upon what basis this supposed relation between sanitation and the legal binding of the coolie rests. There is a general idea that the free coolie is necessarily living the ordinary life to which he is accustomed. This is not the case, for there are great differences to which we shall refer in more detail later, between the life of a cultivator in the villages, such as the coolie is before recruit-

ment, and that of the tea-garden labourer. Nor is it safe to assume that the conditions of life in a newly opened country like the Duars are similar to those of tracts from which tea-garden labour is drawn; and in the Duars the conditions of life especially to the new-comer are both difficult and hostile. It is frequently stated that under a free labour system the coolie can move about from place to place just as it suits him; but were this strictly true it would not benefit him for conditions are everywhere the same in the Duars and by constant change the coolie but emphasizes hostile circumstances. Another general belief is that any coolie, should he desire it, is able at any time to leave the district; but we shall show that such a view does not fully represent the actual facts. Again want of direct relations between the planter and the coolie has been often supposed to be beneficial to the latter; but a close study of the conditions in the Duars seems to indicate that the need of protection is greatest just in proportion to the lack of such a direct relationship.

The so-called "*sardari*" method of recruitment in the Duars differs in a most important particular from the "*sardari*" and other systems of recruitment conducted by Assam, namely, that while in the latter area all labour when it reaches the garden is dealt with directly by the garden manager, in the Duars practically all labour is dealt with through the *sardar*, who does not on the garden cease to have relations with the coolie. The distinction is well drawn in a statement recorded by the Assam Labour Enquiry Committee (*vide* page 2), who in speaking of all labour recruited for Assam say:—

“The fact that while the labourers in other tea areas were recruited and managed through middlemen, in Assam the system of direct management was in force, the recruiter's connection with the labourer ceasing directly the latter had arrived on the garden”.

And it is necessary to realise that though a recruiter in the Duars' system may be an ordinary garden coolie he acts only, as a rule, as a kind of agent for a *sardar*.

The description given by Mr. Arbuthnott (*vide* page 2 of his report) gives a good idea of the actual facts :—

“ The *sardar* either goes himself, or selects, with the Manager’s approval, suitable men *from his own patti or gang* to send down as recruiters ”.

The italics are ours, for men from his own gang means men over whom he has control, either by reason of advances or because of relatives left behind.

Further, in the Duars, a *sardar* controls not only one batch of coolies but receives and controls each year as many more coolies as he or his deputies can bring up. He is in fact a headman who holds more or less in his power a number of coolies from whom he draws the means which enable him to live.

“ If a *sardar* owns or controls a sufficient number of thirty or forty coolies he is allowed a *daffadar* whom he selects subject to approval to look after his interests ” (*vide* Arbuthnott’s report, page 5).

And (page 5 of the same report)—

“ As already observed *sardars* in the Duars draw a commission on each task up to the maximum of two *pice*, and in a manner may be said to own the coolies who have been recruited by themselves ”.

Not only is the coolies’ pay in almost every instance given through the *sardar*’s hands, but it is the *sardar* who recovers advances (*ibid*)—

“ Coolies are usually paid monthly through their *sardars* and their *sardars* either advance them money themselves or recommend advances, the *sardar* in the latter case being responsible. ”

And (page 2, *ibid*)—

“ Advances in the recruiting districts represent money given to new coolies to pay off their debts in their country, road

expenses and sundry. The *sardar* is responsible for these amounts and in turn recovers from the coolies monthly and proportionately ”.

This method of recovery of advances by the *sardar* appears to be left entirely in the hands of these men, who frequently, if not usually, do not deduct a fixed amount monthly, but retain the full pay and allow to the coolie a living allowance until such time as this debt is paid off, a process which usually takes some years, and which is acknowledged rarely to be completed under twelve months.

In the *sardari* system of the Duars, in fact, we have to deal not with a number of amateur recruiters each bringing up a few other coolies with whom their relations cease on their arrival at the gardens, but with a class of middlemen often shrewd, more or less educated, and always capable of looking after their own interests. In his position and functions he resembles very closely the class of “*câporali*” described and condemned by Celli in his account of malaria among the labourers in the Roman Campagna.

Yet it is not entirely a matter of the integrity and humanity of the *sardars* which is concerned.

Looked at from one point of view, one of the most extraordinary conditions in the Duars is the relations between the gardens and the *sardars*. Not only is he supposed to take the chief responsibility of the maintenance of the sick, but to quote from the Proceedings of the Assam Labour Enquiry Committee (page 126):—

“If coolies die or abscond the loss falls on the *sardar*, not on the garden.

And again (page 128)—

“The recoverable advance would be shown on the garden books as a debt against the *sardar* which the garden recovers from him and he in turn from the coolie. As a matter of fact very few of such advances have to be written off as irrecoverable ”.

Mr. Arbuthnott (*vide* report, page 3)—

“Losses occur when a recruiter obtains a bad lot of coolies who abscond on arrival.....This may or may not be recovered from the *sardar* who on occasion himself absconds if the account against him becomes in his opinion too heavy”.

An abstract illustrating the general looseness of the arrangements may be quoted from the Proceedings, Assam Labour Enquiry Committee (page 128):—

“These advances are debited either against the recruiting *sardar* or against his principal on the garden. The *sardars* recoup themselves for the cost of this display out of their commission paid on the earnings of the coolies, and any sums advanced by them to the coolie are recovered from him by the *sardar*”

There is nothing in the *sardars*' emoluments that we can ascertain to enable him to support these losses, and one is forced to see the danger that the coolies who are under the control of the *sardar*, more especially those related to coolies who die or abscond, will have to bear any loss incurred.

In the face of the conditions we have indicated it is impossible to believe that the absence of direct relationship between the planter and the coolie, which characterises the Duars' labour system, does not work greatly to the disadvantage of the latter, or that the system of indebtedness by which the coolie is retained is not prejudicial to his welfare just at a time when he needs all his resources to enable him to resist malaria. The very reason why the system has received so little criticism seems to us sufficient to condemn it. For undoubtedly much of the want of appreciation of the effects of such a system are due to the fact that—

- (a) Only the finest labour is used, because it has been found by experience that only such labour can “stand the climate”.

- (b) There is no means of anyone knowing, even approximately, what the death rate is, or waste of labour involved.

In the next chapter it will be seen how the facts to which we have drawn attention work out. For the present we need only to point out that in the Duars, labour being voluntary, the deduction is that no sort of responsibility attaches to the employer. It is the largely disastrous effects of such a view which we shall show are responsible for the conditions now seen in the Duars.

VI.—ECONOMIC INFLUENCES.

In the introduction we have referred to the fact that every circumstance affecting the physical comfort and well-being of a population has a considerable influence upon the amount of malaria present.

Perhaps there is nothing of more vital importance to the members of a community than that they shall obtain a physiologically adequate dietary, and in the case of a labouring population a diet at least proportionate to the amount of physical work expected of them.

In addition to this, suitable housing, clothing, fuel and the ability to indulge in occasional little luxuries such as tobacco, etc., are in their general effect on the condition of the individual essential to a condition of physiological well-being. In the absence of these conditions we shall have hardship and physiological poverty, the second great factor that we have indicated as profoundly influencing the incidence of malaria.

FOOD.

In the Duars the monthly pay of the coolie is stated to be Rs. 6 for a man, Rs. 4-8-0 for a woman, and Rs. 2-8-0 to Rs. 3 for a working child. During certain times of the year industrious coolies can earn considerably more than this, but in 1900 the Deputy Commissioner of Jalpaiguri estimated that the average earnings of the most industrious out-door male labourer would not reach as high a figure as Rs. 7-8-0 *per mensem*. The actual amount earned by a labour force is, however, much less than this, totalling on the average, inclusive of extra "*ticca*" as noted in the Assam Labour Report, Rs. 4-9-0 for men, Rs. 3-7-0 for women, and Rs. 1-0-5 for children, each month in the year. This is stated to be the amount the coolies are "content to earn". It is necessary for us to enquire very closely into this statement, since on such pay with prices of foodstuffs at the level they have maintained during the last few years it is, we believe, not possible for coolies to obtain an adequate dietary.

In regard to average total earnings it must be remembered that the figures—

- (1) Take no cognisance of the “advance” which has to be recovered in the case of many persons, and *certainly all new coolies*.
- (2) The fact that the amount is paid into the hands of the *sardar* and not to the coolie himself.
- (3) The total amount earned by a labour force has to feed not only the number of labourers on which the average pay is calculated, but the total garden population of the coolie class.

This is all the more important since in the Duars actual workers, *i.e.*, the labour force, number only about one-half of the total coolie population on the garden.

Certain coolies no doubt supplement their pay by growing rice, vegetables and so on, but this cannot apply generally, and more *especially does not assist the vast majority of new-comers*.

The price of foodstuffs in the actual market in October we ascertained to be as follows :—

Dhan 12 to 16 seers per rupee.

Rice (unboiled), good, 6 seers per rupee.

Rice (boiled), good, 6 seers per rupee.

Rice (boiled), coarse, 7 seers per rupee.

Dals, various kinds and qualities, from annas $2\frac{1}{2}$ to 3 per seer.

Salt, annas $1\frac{1}{3}$ per seer.

Oils, annas 10 per seer.

Chilis, annas 4 per seer.

Other condiments from anna 1 to annas 5 per seer.

Potatoes, annas $2\frac{1}{2}$ per seer.

Onions, annas 3 per seer.

Fowls from annas 8 to Re. 1 each.

Mutton and goat and other flesh in proportion.

Tobacco, annas 12 per seer.

There has been in recent years a great advance in the price of *dhān* and rice, which now costs nearly twice as much as it did in 1903, when the average price for rice in the Duars was Re. 1 for 12 seers.

What an adequate diet for a coolie may be it is difficult to say since it varies so much with different circumstances, notably with the amount of work he is doing.

When at work, however, a man will often consume more than a seer and not less than 12 *chittacks* of rice in the day, exclusive of other additions, in the shape of dal or vegetables. The diet for coolies travelling on the Assam steamer routes is fixed as follows :—

Rice, 12 *chittacks*.

Dal, 2 *chittacks*.

The cost of such a dietary for a month of 30 days, apart from any necessary additions in the shape of oil, salt, and condiments, on a scale of prices similar to those ruling in the Duars at the present time, will be Rs. 3-12-0 for the very cheapest quality.

The famine code dietary is—

(1) For labourers on light work, rice 14 *chittacks*.

(2) For labourers on hard work, rice 18 *chittacks*.

The price of rice alone in such a diet at the Duars rates would be Rs. 3-11-0 and Rs. 4-12-0 respectively at the lowest rates. A labourer in the Duars can by buying *dhān* and husking it reduce the cost of his rice by about 25 per cent. He can also grow a few vegetables or secure from the jungle a few herbs and roots or occasionally obtain fish from the streams. All these extra sources, however, require time or facilities not available to the new coolie and the following of such pursuits often means, where there are no dependents, the sacrifice of wages on the part of the worker. It is evident then that very little margin is left for even a minimum living diet. This accords with our observations; among new coolies we find the standard of actual diet taken is very low.

We are told that the average coolie in the Duars does not work for more than from 15 to 18 days in the month. Why is it then, it

may be asked, does not the coolie work more and earn a greater amount? In attempting to arrive at an answer it is necessary to bear in mind that—

- (1) Under the Duars' system a new coolie on his entry into the country is already indebted to his *sardar* for the advance he has received, and for his train fare and journey up. This advance is usually recovered from him, not by the deduction of a fixed monthly amount from his wages but by means of an arrangement which may be called the giving of "living allowance". Under this system the *sardar* allows a certain amount for maintenance, and himself takes whatever the coolie's pay may be until such time as the advance is paid. When it is remembered that the average total monthly wage of a man is less than Rs. 4 and that of a woman less than Rs. 3 paid through the hands of the *sardars* (not including the small average amount of "*ticca*" paid direct into the hands of the coolie (*see* Assam Labour Enquiry Committee Report) it will be evident that the average "living allowance" must be still less. So far as we can ascertain it is in the case of a man, never more than Re. 1 per week and becomes reduced just in those cases where circumstances press most acutely as when sickness or weakness has once asserted itself.
- (2) The effect upon a working coolie of an inadequate diet is, we believe, at once to force him unconsciously to attempt to keep his physiological balance by stopping work. We believe then that one result of the *sardar* system of payment and the recovery of advances leads in this way to a frequent condition of "laziness", if it can be called this on the part of the labourer arising really from physiological causes and that there is a grave tendency for the occurrence of a vicious cycle of inadequate diet, sickness and unwillingness to work, the nature of which when brought about is unrecognised by all concerned.
- (3) Any sudden call obliging the coolie to obtain even a small sum of money necessitates further indebtedness to the

sardar, who thus, if he wishes to exercise them, has all the privileges of a money-lender. . Again, if for any reason such as sickness the coolie does not work, though he may still draw his living allowance, his debt to the *sardar* remains or increases and payment is correspondingly delayed. As a result many coolies remain for years drawing merely a "living allowance" instead of their pay.

- (4) Under existing conditions "sickness" is not a mere occasional occurrence, but a condition to which the non-immune coolie is almost necessarily liable. Whilst sick the coolie is "provided for by his *sardar*" and since his *sardar* draws commission for his work and gains by his pay, it may be presumed that the *sardar* desires the man's recovery; but it is by no means probable that the *sardar* understands the necessity of a physiologically adequate diet or the value of proper treatment for sickness. Again no doubt a man draws his living allowance more or less as usual when first sick, but if his disability is frequent or he does not rapidly recover, his *sardar* must eventually reduce his allowance. The man is perhaps a loss to the *sardar*, he is anæmic, apathetic, useless, so the *sardar* has to decide whether he is worth keeping or not. Under the present system there is nothing to prevent the *sardar* definitely cutting such a man adrift, a case not imaginary though of course representing the worst that may happen. In ordinary cases the train of events ends in a semi-apathetic state of the labourer and his loss to the garden as an active worker.
- (5) The coolie is not always endowed with the foresight necessary to make him endeavour energetically to work off his advance against perhaps his own physical disinclination. And once he realizes that his indebtedness is indefinitely bound upon him, his object becomes to do sufficient work to satisfy his *sardar* and earn just a little more than his living allowance, for if he earns more than this it is not he who benefits but the *sardar*.

- (6) If a coolie once becomes involved in the vicious cycles that beset him, he is likely to find great difficulty in getting out of them.

It may be said that the average coolie in the Duars is well off, and that the considerations that we have just discussed do not apply to more than a certain number. We are well aware that among the older coolies many have attained a condition of comparative comfort; but this does not alter the fact that every new coolie entering the Duars has to encounter conditions such as we have described, a totally new environment to which he must accustom himself before he can hope to thrive. In other words, the new coolie must become acclimatised to these conditions as well as to the effects of malaria to which they strongly predispose him; and we believe that one of the main reasons why the aboriginal races from Chota Nagpur have been found as a matter of experience to "stand the climate" of the Duars better than any other class of labour is not because they possess racial immunity to malaria, a disease which seems not particularly prevalent in their country, but because for many generations they have been habituated to hardship and privation.

In this connection we wish to make it quite clear that it is not the question of the pay the coolie draws on paper that concerns us, nor even the food he buys. Our interest is entirely centered upon the food which he actually eats, for this undoubtedly bears a definite relation to the question of his bodily fitness and ability to withstand malaria. To reduce the effects of malaria in a community it is not so essential that it should be paid highly as that it should be well-fed; and the two conditions are not necessarily coincident. How far from absurd such a view is will be clear from an abstract describing the methods used in bringing about the great sanitary triumph in the Panama Canal zone :—

"Two towns that were practically cities of mud and malaria had to be drained, cleaned and supplied with water for all purposes. A working population unaccustomed to habits of cleanliness had to be disciplined and properly housed. A commissary department had to be establish-

ed, and curiously enough the workmen employed had to be compelled to eat. The workmen thus far engaged are in the main the easy-going negroes of the West Indies. Moved to the less healthful climate of the canal zone and compelled to labour instead of idling their time away, they would rapidly lose strength and health unless properly fed. In one of the reports issued by Colonel Gorgas there is made the curious statement that it proved easier to supply uncooked food for these workmen at ten cents a day than to persuade them to eat it; so it was determined to charge them thirty cents a day for cooked food, and to deduct the price from their wages. Since the labourer is compelled to pay whether he eats or not, it has been found that he will eat. As long as he had the option of not paying or eating, he would endeavour to live as he did in Jamaica or Santo Domingo on a banana or two a day and save his money against his return home. Too often his insufficient food sent him to his long home."

"This is one of the many lesser problems which Colonel Gorgas has had to solve, and which, sounding trivial, have been in fact most serious ones."

This abstract is quoted not because it is suggested that the methods adopted by Colonel Gorgas in the circumstances mentioned are suitable for India, where caste prejudice would render their application often impossible, but because we wish to make it absolutely clear that the question of alimentation cannot be neglected if malaria is to be dealt with. As matters stand there is no adequate consideration given to such fundamental questions and they are customarily put aside by the everywhere present notion that the coolie, being a free agent, can and must make his own arrangements, and that the less he is interfered with the better. The limitations of such an outlook are apparent.

HOUSING.

As in the case of other matters, so in regard to the provision of housing, we have in the Duars no "protection" of the coolie; and

the fact that no one is responsible for the provision of suitable dwellings falls most heavily on the new coolies. An ordinary coolie line to casual observation usually appears to be a more or less straggling collection of thatched huts with walls composed of thin layers of thatch grass interlaced with bamboo. More careful examination shows, however, that houses may be differentiated; and it soon becomes possible to pick out the houses of the more permanent residents from those of the newer coolies. The house of the settled coolie, while mainly composed of material similar to that of the other houses, is generally provided with a raised mud plinth extending below the eaves which are widened in front to form a small verandah. The house too generally contains two compartments and is plastered within and frequently on the outside also. The thatch also is generally of a thickness sufficient to afford ample protection from heavy rain. It will be seen that the old settled coolie can take care of himself very well as regards housing. But in the case of the new arrivals and a large proportion of the less settled coolies things are far different; and as a part of the general principle of leaving the coolie to make his own arrangements, it frequently happens that such people are exposed to very great hardship. The custom universal throughout the greater part of the Duars is for coolies to be given on their arrival a certain amount of material, usually bamboos and thatch grass, and to be allowed several days to build their own houses, either where they like or in parts of a line allotted to them. In other cases where labour is short the houses are built by contract; and in some instances steps have been taken to prevent the houses being built too close together. In the main, however, with few exceptions the houses provided throughout the Duars conform to one type. This type, except to superficial view and as regards the primary materials used, is very different from the houses of the settled coolies even in the same line. It is built with a bamboo framework on the ordinary level of the ground, with a minimum of thatch on the roof and a thin screen of the same materials to the four sides to form the walls. It may be built of single compartments ten or twelve feet square, or a house twenty by ten may be divided into two compartments, in each of which from two to four single coolies are accommodated. The door-ways are usually closed with movable thatch or laced bamboo screens.

The idea generally held and frequently expressed is that this type of house is the one built by the coolies themselves, and therefore must be according to their liking and in every way the most suitable for them. But this is not a full statement of the facts. It is true the coolie who is a new-comer builds the primitive type of hut described; but if asked whether he is accustomed in his own home to such temporary dwellings he explains that he is not, but that the lack of material or more frequently the limited time allowed him does not enable him to construct a better house. If his attention is called to the superior residence of the permanently settled coolies, he usually replies that, as he is never certain how long he may remain, it is useless to spend his own time and labour on what may be only the most temporary home. As such, a large proportion of the garden coolie population is either new or semi-permanent, it thus happens that the majority are housed in a manner at once primitive and temporary. It is not our intention to put forward any type of house as necessary or desirable, the point that seems to us important is that at the present time there is no recognised obligation upon the employer in regard to house accommodation for coolies, the type of house provided very often being the very minimum that can be offered, and far below in point of comfort, cleanliness, or as a shelter from the weather, the kind of house which the favourably situated coolie in the Duars cares to occupy of which one may see examples here and there on every garden and almost everywhere in the neighbouring villages.

Clearly it is the new coolies who are most likely to suffer from this condition of things, and as a matter of fact we have seen such coolies obviously enduring considerable hardship on account of inadequate or unsuitable accommodation. We have seen 14 people—men, women and children—huddled together in a hut of the kind described, measuring only 16 by 10 feet. We have seen families of new coolies—up about a month from their country, in huts of the same kind built level with the ground and subject to flooding with every heavy fall of rain. In one case where the houses were visited late at night in company of the manager, cases of cholera having been reported, the occupants of such houses—men, women and chil-

dren,—all new coolies, were found sleeping on a little straw on the bare ground, which was still covered with green grass.

Fires are a frequent occurrence, the custom of building the houses—both roof and walls—entirely of such inflammable materials as thatch and bamboos increasing very greatly the danger of fire to which coolie lines are always liable ; and owing to the very common neglect of proper spacing such fires sometimes destroy many houses in a line and render a large number of people homeless. One result of this is the exposure of such people to special hardship. An example of this was seen by us. As a result of a fire two families were forced to find new quarters. One family consisting of a man and his wife obtained shelter in a house already containing a family ; the other consisting of a man and his wife and child were less fortunate, being reduced to occupying half a little cowshed. At a subsequent visit it was found that the man had died (from cholera?) and the woman had gone with her child to another garden. We have seen a fire in which no less than thirty houses were destroyed just before the onset of the rains, and as far as could be ascertained the people who were thus deprived of shelter had to seek accommodation in other houses already occupied with their full complement, or to leave the garden with a view to finding homes elsewhere. In one case after an extensive fire we saw many families camping out through the rainy season under pieces of tarpaulin, etc. We have mentioned these instances merely to illustrate the point that we consider of importance, that owing to the lack of any obligation to supply more than the minimum of housing accommodation necessary to retain labour the standard being fixed only by what is customary throughout the district, coolies, especially those who are new-comers or otherwise unable to look after their own interests, are often subjected to exposure and hardship to which they are not accustomed and in a climate which is very different from that of their own country. As a result the weaker among them especially suffer and large numbers even among the more robust are under these conditions rendered more liable to become the victims of malarial infection.

GENERAL SOCIAL CONDITION AND STANDARD OF COMFORT.

It is generally taken for granted that the free coolie under circumstances such as we have described, is existing under conditions

to which he is accustomed. Yet consideration will show that this is far from being the case. The following are some examples of changes which may appear trivial to some, but are really matters of importance and affect the coolie to a far greater extent than might at first sight be imagined.

(1) The coolie is either drawn from the ranks of (a) independent cultivators or (b) landless labourers. In the one case he is accustomed to depend upon a store of food stuff of his own growing, in the other case he almost invariably receives his daily food ration as part of his pay.

Under his new conditions he has to calculate and arrange to purchase a weekly supply of food from the local market.

(2) In their own country the vast majority of the people from whom the tea garden coolies are drawn are used to deal in kind, not in coin. *Dhan* or rice is practically their standard of value and many of their purchases are by barter.

In the Duars they are all forced to deal in currency and calculate an expenditure upon an average wage which as we have seen allows of no margin.

(3) The average coolie has in his own country been living in a comparatively healthy climate, very dry for the greater part of the year, and the house to which he is accustomed is usually both comfortable and substantial.

In the Duars he finds himself exposed to the discomforts of a climate at one time excessively wet, at another dry and often cold. His house is usually as primitive and comfortless as it can well be, and in addition in his new conditions he becomes subject to malaria, if not to actual cachexia or anæmia.

Settled coolies are generally fairly comfortable, but our impression is that for the first few years of their stay in the Duars the ordinary coolie frequently lives in poor condition with a low standard of comfort. They frequently have inadequate clothing and very often their remaining worldly possessions are only a couple of cooking pots.

It is said that the coolie if he wishes it can leave the garden, but unless he leaves the country he will not improve his condition by doing so, and under the *sardari* system he is tied by his advance so that there does not seem much likelihood of the average coolie being able to adopt the latter course. His only chance is an advance from his *sardar* to cover the cost of his journey, and unless a coolie so indebted can be trusted to return, or to provide a substitute, he is not likely to obtain this. The coolie already heavily in debt will certainly find it difficult to get away. Many coolies do leave the Duars temporarily, or permanently, but these for the most part are the ones who have prospered, and those who are going to recruit, or others who have come to the Duars with the intention of remaining only a few months.

Perhaps one of the most striking object-lessons in the Duars is the condition of the "bustees" or villages where the old coolies have settled down to cultivation. A distinction must be drawn between true villages and "bustees," which are in reality only garden lines situated on or off garden land. In the case of the latter, things are much the same as those already mentioned, but when we come to the true village communities we generally find conditions very different to those general on the gardens. The houses conform to the type already described as the ones with which the permanent garden resident usually provides himself, well built with plinth and verandah and plastered within and without. The children are generally found to be fat and healthy, the people usually cheerful and showing evidence of existing in fair comfort. Yet these people almost always are to be seen living in places that would be picked out as the most swampy and presumably most unhealthy situations in the district, such places being, of course, the most suitable for rice cultivation.

VII.—SICKNESS AND ARRANGEMENTS FOR THE MEDICAL TREATMENT OF THE SICK.

SICKNESS.

The amount of sickness is very great. Among 100 persons examined in one line 16, not counting young children, were definitely ill with fever, anæmia, etc. In a portion of another line containing a total population of 146 persons, 70 adults were away, 32 at home. Among these latter 6 were found to be seriously ill. During the healthiest season of the year in a line containing about 3,000 total population 14 cases of serious sickness were found, 12 were malaria, one phthisis and malaria, and one dysentery and malaria. In a line containing about 279 people, 26 were either themselves sick or were prevented from going to work on account of children seriously ill. In a line visited in September every house occupied had one or more persons sick; and in another line, in a different part of the district during the same month, we found a nearly similar condition of things, many families showing more members sick than healthy. In three houses in a group, in a line containing new coolies, we found in the first house 12 people from Orissa, of whom six were ill with fever. In the second were two Santals; the wife was ill with fever and spleen, the husband at work. In the third house were two Ooryas, the husband was ill with fever and a large ulcer, and the wife was at work. In the case of a family of four new coolies from Lohardugga we found only one old man able to work, two of the coolies having fever and one a large ulcer. In a house with six persons, three young adults and three children, two adults and a child had fever. In a house with two coolies, a man and a boy of ten, who had been up a month from Dhumka, both were laid up with fever. In a small garden with about 300 or 350 working coolies, 31 were seen who had been incapacitated from work for a considerable time owing to serious illness; 21 of these were suffering from intense anæmia.

In a house were a married couple, their son's wife, a daughter and a child of 8. The child's father (their son) had died, the old man and woman had to be helped to walk to the *sardar's* house, the daughter was intensely anæmic and apathetic, the mother was seen sitting in the verandah with fever, miserable and apathetic; the child had a

suppurating scalp. At another place a family of new coolies was found consisting of two old people, their son, his wife, and four children, the eldest old enough to work. The two old people were in a condition of great debility, the eldest girl was ill and the youngest child, an infant at the breast was also so ill as to prevent the mother working. A youth of about 18 was seen dying from intense anæmia, dropsy and dysentery in a little lean-to shed adjoining another house. He had no relations, and there was no one looking after him. His *sardar* was supposed to be supplying him with food, but there was no sign of food, no fire, although it was cold weather, and the boy had no blanket. A Paharia woman was seen in one of the houses together with a child of five, the woman was suffering severely from phthisis and could not stand, the child had chronic dysentery and was a mere skeleton, the husband was at work.

A woman and her daughter, nine months from Nepal, were both found to be seriously ill. The woman was intensely anæmic; the girl was emaciated and scarcely able to stand, appearing very apathetic with intense anæmia and very large spleen. A man and his daughter belonging to the same batch were both ill. The man was extremely anæmic and intensely apathetic, the girl greatly emaciated and too feeble to remain standing. On one of the medium-sized gardens in June, no less than 63 severe cases of ulcers were seen, in each case incapacitating the subject from work; many of these cases were of more than a month's standing. In another garden in a Paharia line with about 15 houses, there were about a dozen severe cases of ophthalmia, six cases of fever and anæmia and five cases of dysentery. One old woman, who was very seriously ill, had no relations and no means of getting even water which was at a considerable distance. In another case a woman was found suffering from intense anæmia and dropsy, she had been ill for six months, her husband had died and her only support was a small boy of about ten. Instances of this kind could be multiplied indefinitely, especially wherever large drafts of new coolies are concerned.

PREVALENT DISEASES.

The great majority of cases ordinarily met with are malaria and its sequelæ. In addition there exists to an extraordinary extent, notably

among new coolies, a condition of impaired vitality and anæmia. On one occasion an inspection of adult leaf pickers, who were seen bringing in leaf on one garden, showed among 81 males 40 with marked pallor of the conjunctiva and other signs of severe anæmia, while among a total of 75 women 34 were similarly intensely anæmic.

Apart from malaria the following diseases assume from time to time considerable importance in the Duars :—

Cholera.—No serious outbreak has come under our own observation, but we have been informed that cholera is by no means infrequent, and that there have been a number of instances where it has broken out with disastrous results among garden coolies. The most serious outbreak of which we have heard on a garden occurred in 1906 when over 200 coolies are said to have died in one week.

In the same year to our knowledge, three other considerable outbreaks took place on gardens in one instance with 70 deaths. We heard of another outbreak in 1907 where 45 coolies died within a month.

During the course of our enquiry occasional cases have been encountered by us and in one case 5 deaths from cholera took place during the few days we were upon the garden, while we heard of other deaths on several adjoining estates. The conditions referred to in the chapter on Sanitation are mainly responsible for these occurrences.

Phthisis.—Phthisis is especially prevalent among the Paharia coolies from Nepal and the Darjeeling hills. It is impossible to give the actual incidence, though we have seen a large number of cases and it appears to be an important cause of sickness and mortality among certain classes of the population. We have not visited a single garden in which we have not seen one case, and where hill coolies are present in large numbers we have generally come across from three to five cases, but the absence of any reliable record prevents our obtaining any precise information regarding the prevalence of the disease.

Ulcers.—An extremely important condition involving a great amount of inefficiency is a form of phagedenic ulcer especially common

about the time of the early rains and prevailing in epidemic form. These ulcers usually attack the lower third of the leg; and while no particularly intractable to early and thorough treatment they become when neglected or left to the careless methods and inadequate attention of the ordinary Duars' "doctor babu," the source of much suffering and disability among the coolies, many ulcers remaining unhealed for months. The ulcers appear to have a specific origin and a large bacillus occurring in the granulation tissue is possibly the casual agent.

Diseases of the eye.—Diseases of the eye, notably infective conjunctivitis, are very frequent, and in the absence of effective medical arrangements, exert very serious effect upon large numbers of the population. The actual cases of conjunctivitis that occurred in the Duars during 1908 must have run into many thousands. At the time that the disease was prevalent from March onwards, numerous cases were seen on every garden visited; over a hundred cases were seen during a brief stay on a garden with a total population of about 900 people. The disease attacks both children and adults, and whole families may be seen suffering at the same time. We have been told that it recurs more or less severely every year, but no steps appear to be taken to check or limit the epidemic. In the case of one garden where very large numbers of the coolies were seen to be suffering from the disease, the "doctor babu" was away on several months' leave and there was no substitute to attend to his duties.

Kala-Azar.—In the absence of hospitals and under the existing lack of medical system splenic puncture is rarely possible, and the amount of Kala-Azar infection cannot be gauged; but clinical evidence does not show the disease to be prevalent in the Duars, and though occasional sporadic cases may be met with, Kala-Azar does not figure largely in the pathological picture of the district.

Small-pox.—This disease occurs from time to time in the form of more or less isolated outbreaks. We have heard of some three or four such outbreaks during the present year on widely separated gardens. We are informed that vaccination on the gardens is carried out by Government vaccinators who, it is stated, are paid by the coolies for

their services. We have not heard that the medical staff of a garden is responsible for vaccination in any way.

Epidemic dropsy.—Several considerable outbreaks of epidemic dropsy occurred during the course of our enquiry in the Duars. In some gardens a hundred coolies or more were attacked, but the mortality from this disease appeared to be trifling. We saw a considerable number of cases on one garden, but no serious ones, and the epidemic soon disappeared.

Plague.—No case of this disease has come under our notice, and we have not heard of any case having been recognised in past years in any part of the district.

ARRANGEMENTS FOR TREATMENT OF THE SICK.

The arrangements for the treatment of the sick in the Duars consist of—

- (1) A European medical officer in each sub-division.
- (2) A so-called “doctor babu” on most gardens.
- (3) A building or part of one, utilised as a medical store-room and dispensary.
- (4) A coolie to assist the “doctor babu” and carry round medicines to the lines.

The European medical officer, to quote Mr. Arbuthnott’s Report on the Duars (*vide* page 8), “is not retained on account of the coolies, nor is attendance to the labour force regarded as his legitimate work, though he would be called in to attend to a serious case or in the event of an epidemic.”

In some instances the medical officer is supposed to give some general oversight to the medical arrangements for the coolies; but the “doctor babus” do not appear to be directly responsible to the medical officer, while the absence of real facilities for serious medical work among the coolies renders such supervision as may be given more or less futile.

The native medical officers or "doctor babus," except in a very few cases, are unqualified or possessed of qualifications of the most doubtful character. We have only met six of them who held the diplomas of a hospital assistant. Apparently anyone who cares to call himself a "doctor babu" may be engaged.

Their medical knowledge in our experience is extremely limited and their treatment of the sick as it affects the general coolie population is in our opinion in the great majority of cases of no value whatever. The making up and the administration of coolie medicines is generally done in a most casual and unprofessional way. Fever, if treated at all, is, as a rule, ignorantly and inadequately treated. In a case of fever lasting several days we have seen a single five-grain tabloid of quinine given. Ulcer cases are almost completely neglected, and, except when a manager interests himself specially in some case, a little powder or carbolic oil is given to the coolie, who is left almost entirely to his own resources for dressing the sore.

The following instances will serve to indicate the general laxity and incompetency of the methods of medical treatment afforded the coolies by some Duars' "doctor babus":—

- (1) A "doctor babu" was found preparing a gargle for a woman dying of tetanus.
- (2) A "doctor babu," as we were informed by one of the European medical officers, gave a woman gr. 20 of calomel and was not aware that he had done anything unusual.
- (3) A "doctor babu" was seen on his rounds interrogating a sick coolie who appeared to have fever. Having decided to administer a dose of opening medicine he told the coolie following him with a box of medicine bottles to give the coolie some *jalap*. His "*dawai-wallah*" promptly took a small piece of dirty newspaper and poured into it by guess a small quantity of P. Jalapæ Co., not more than 10 grs., a quite inadequate dose, which he wrapped in the paper and handed to the coolie. The "doctor babu" took no interest in the matter beyond giving the coolie his orders.

- (4) A "doctor babu" was seen during an epidemic of ulcers to be cauterising all his cases with strong nitric acid and in such a manner that the acid ran down over the limb burning deeply and increasing the mischief. So far as we could see these ulcers got no further treatment than applications of acid.

In our experience coolies are by no means averse to accept treatment if they realise that it is likely to be of any use. That they do not trouble to avail themselves of treatment under present conditions is not surprising in view of what we have seen of the character of the treatment usually meted out to them.

The recording of sickness and the number of births and deaths which is generally the duty of the "doctor babu", is performed in a most perfunctory manner, many of the babus being grossly careless or wilfully deceptive in regard to these matters. Many believe that the report of too many deaths will lead to their being considered incompetent.

In regard to sick records it was interesting to note that on one garden where a sick register was being kept, the average number of sick shown rose during the four days of our stay from 13 to 15 to as many as 33 to 34 per day. The working population of this garden was about 450 and the sick shown were workers who were incapacitated for more than one or two days. On another garden with a very large population numbering over 2,000 the record of daily sick on the occasion of our visit was only 6 persons.

As we have already stated hospitals do not exist in the Duars, and there are no facilities for the treatment of surgical or other in-patients. Dispensaries also, in the ordinary acceptance of the word, are almost entirely absent. We know of three or four only to which the term might be applied with any accuracy. In almost all gardens, however, a room or part of a building is set aside for the use of the "doctor babu" in preparing and keeping his medicines. On some of the larger gardens seen by us the medical stores were ample in

amount, and there were the usual dispensing appliances and dressing instruments, but in many cases the supply of necessary drugs was altogether inadequate and out of proportion to the actual sickness on the garden, while too often it appeared that the stocks of medicines accumulated from year to year with little evidence of any intelligent attempt to use them in actual treatment.

We have been informed that at one time an attempt was made to introduce hospitals as in Assam, but that the scheme failed as the coolies refused to utilise them. That many coolies dislike becoming in-patients at a hospital, we are aware, but how far the supposed failure of hospitals in the Duars was due to defective administration and the nature of the medical treatment offered it is impossible to say.

GENERAL EFFECT OF MEDICAL ARRANGEMENTS. . .

The present system under which the coolie population of the Duars obtains medical treatment is most inadequate. However large or however scattered the population of a garden may be, the same staff of a single "doctor babu" is considered as amply sufficient. Even this staff, as we have noted, is often selected without reference to qualifications. When leave is taken it is rarely considered necessary to appoint a deputy, and a "doctor bubu" may even be sent away for months to the recruiting districts while his duties are unattended to; or he may for part of his time be employed on clerk's duty, it being thought or taken for granted that his medical duties are insufficient to require his whole-time service.

The origin of the mischief seems to be that, no one being responsible for the health of the coolie, the treatment of the sick as well as sanitary arrangements are matters to which no serious attention is paid. Deep at the root of the whole matter is the present labour system with its lack of registration and general irresponsibility for the life and health of the coolie.

Under it the idle and incompetent "doctor babu" has everything in his favour, for there is no possible means of checking his work or its

results. Provided the daily muster of coolies at work is not below the average he may attend and report as sick as few coolies as he likes. Even were well-trained and qualified native hospital assistants to find employment in the Duars the absolute lack of hospitals and all facilities for successful treatment of disease would immediately discourage any capable man from remaining, for such a man by his very keenness would at once gain the reputation of being both expensive and unsuccessful.

VIII.—VITAL STATISTICS.

By the census of 1891 the tea garden population of the Duars was shown to be 62,313, and ten years later the census of 1901 gives the population at 133,207; recently it has been roughly computed at about 150,000 people—men, women and children. This increase is the result of large and continual immigration, with one aspect of which we have dealt in another chapter. Precise information regarding the amount of immigration is not available; but there are, as we have seen, reasons for supposing that the annual influx into the tea gardens of the Duars has rarely fallen short of 15,000 persons and may sometimes have been as great as 30,000.

Regarding the number of coolies leaving the Duars for their own country, there are even less data. Each garden sends down annually a number of recruiters, who generally return, and in addition there are people who return home independently. But the number returning home is not, so far as we can ascertain, more than 10 per cent. against 25 per cent. of the total in the case of those entering the district annually. On this question Mr. Arbuthnott says (*vide* page 6 of his report):—"The impression that the bulk of any labour force visit their homes annually in the cold weather to return after the harvest is over is, however, incorrect, whatever may have been the case formerly."

On one garden with a total population of about 1,200 we were informed that 28 people were returning to their villages for recruiting purposes in 1908. Mr. Arbuthnott records that a garden with 900 working coolies sent down in 1904 some 38 recruiters and that 78 others returned to their country independently. In the years 1901 to 1903, 12 gardens with an aggregate of 11,000 acres under tea, sent down a total average of about 700 recruiters each year. These returned with an average of about 3 coolies each.

In addition to this yearly movement to and from the recruiting districts, large numbers of the coolies pass each year from one garden to another, and a further number definitely leave the gardens and become settlers in the villages. There are no figures to indicate

to what extent this colonisation takes place, but it does not appear to be very extensive.

The population on particular gardens varies greatly, but, roughly speaking, appears to average nearly two persons per acre of cultivated tea. An average garden has a population of from one to three thousand, but on large gardens as many as from three to six thousand residents may be found. On a few very small gardens the population may number only some hundreds.

REGISTRATION OF VITAL OCCURRENCES.

The *Chaukidari* Act is not in force in the tea gardens of the Duars. The *chaukidars* who are responsible for reporting births, deaths, etc., to the nearest police station once a week, are maintained under a special arrangement and paid by the estates.

The birth and death-rates on the tea gardens in the Jalpaiguri district for 1906 and 1907 are given in the Sanitary Report for Eastern Bengal and Assam as follows:—

	Birth-rate.	Death-rate.
1906 ..	8·34	22·23 per mille.
1907 ..	19·54	18·45 „

It is needless to remark that these low figures are due merely to defective registration, the returns submitted by the gardens under the present system being in the main quite worthless.

There are several causes in operation which must tend to render registration on the tea gardens as at present carried out practically futile:—

- (1) There is no responsibility entailed upon the gardens to submit accurate returns.
- (2) The books of a garden do not show the total coolie population, but only a labour roll; and in the last census it is generally admitted that frequently double the population supposed to have been resident on the garden were actually found.

- (3) The garden managers, though they keep a register for deaths among working coolies and are stated to report these to their agents in Calcutta, have generally the idea that, in the case of deaths among those not in the actual labour force, registration is not very important. As the majority of deaths occur among young children and adults *who by reason of long sickness have very frequently ceased to appear upon the labour roll*, and have practically been lost sight of as members of the population, there is introduced a very serious source of error.
- (4) The returns to the *thana* are frequently not prepared by the *chaukidars* themselves, the usual practice being for the garden clerk or 'doctor babu' to write them up in the *chaukidar's* book.
- (5) Under the present system it is a matter of pure chance whether the clerk or 'doctor babu' are even informed of a death or birth, there is, moreover, no check upon their figures, and there is no reason to believe that they are made to consider it an important matter to give complete or accurate returns.
- (6) It is the aim of some 'doctor babus' to report as few deaths as possible.

The general carelessness and want of method displayed is particularly evident in the birth returns and is exemplified in a statement that was made to us on one occasion, that from one garden no birth return was submitted to the *thana* for two years. It is probable for reasons such as have been pointed out that the registration of vital occurrences on tea gardens in the Duars is much less accurate even than that obtaining in villages where *chaukidars* or headmen are responsible.

ACTUAL DETERMINATION OF MORTALITY.

Since statistics compiled under the present system have no value, we endeavoured to arrive at an approximate idea of the death-rate in the Duars by actual observation.

A line was selected in which conditions appeared neither better nor worse than the average; it was mapped and numbers given to the houses. Three enumerations were made, one at the end of May, the next at the end of August, and the third at the end of November.

The lines population comprised people from the following localities :—

Chainpur.	Gumla.
Beru.	Palkot.
Ranchi.	Surgaja.
Jaspu.	

These are all *thanas* or sub-divisions in Chota Nagpur, and the race that which, it is universally admitted, stands the Duars better than any other.

The period of six months during which our observations are recorded also represents a portion of the year in which the total recorded deaths in the Jalpaiguri district have averaged during the last three years 48·9 per cent. of the total for the year.

The full observations are recorded in Appendix II, but an abstract of the results is as follows :—The total population at the end of May was 302, consisting of 115 men, 97 women and 90 children. Of these, 219 were old coolies and 83 coolies who had come up within the last two seasons. Among old coolies 145 were adults and 74 were children, and of the new coolies 67 were adults and 16 children. Of 102 adults in 38 houses, 70 were away at work and 32 at home. Of 44 children from the same houses 22 were at home. Of the 32 adults at home 5 had fever when seen.

During the six months of observation the following changes occurred :—

(1) Deaths numbered 14 and were distributed as follows :—

Among 115 men	..	.. 3	} or 5 deaths among 212 adults.
Among 97 women	..	.. 2	
Among 76 children over 2 years	..	.. 3	} or 9 deaths among 90 children.
Among 14 children under 2 years		6	

Classified differently these figures showed—

Among 83 new coolies deaths were as follows—

67 adults	..	..	..	4 deaths.
14 children over 2 years	..	..	..	0 „
2 infants under 2 years	..	..	..	0 „

Among 212 old coolies deaths were—

145 adults	..	..	..	1 death.
62 children over 2 years	..	..	..	3 deaths.
12 infants under 2 years	..	..	..	6 „

- (2) Births among the whole population numbered 8, there being
4 among 28 new coolie women and 4 among 69 of longer
residence.

The number of persons concerned is so small that these figures are only approximately representative, but the extraordinary results obtained are exactly in accordance with the general observation of what we believe holds good throughout the Duars.

In one case, on a garden with a total population little more than 1,000 persons, 28 deaths were recorded in three months, though only 19 were returned to the local *thana*, and two more deaths among young children were subsequently discovered to have taken place. In this connection it is interesting to recall that as a result of a special enquiry conducted in the Darjeeling *terai* in 1892, it was shown that the mortality among the tea garden population there was 106·6 per mille for 1891 and 91·0 for 1892, whilst on one garden we were informed on good authority the death-rate was 115 per mille. The Darjeeling *terai* forms what is practically a continuation of the Duars west of the Teesta and conditions there are little, if at all, different from those obtaining in the Duars.

Our figures refer to a community of people drawn entirely from Chota Nagpur. What the death-rate among Paharias, Kols and Santals is we cannot say, but it is probable that the Paharia and weaker plains people die in far greater numbers than our figures for good class Chota Nagpuris indicate.

With regard to children born or introduced into the Duars at least half seem to die before reaching maturity. An enquiry among 27 married coolie women belonging to various tea gardens showed that they had between them 47 living children, while no less than 56 or 57 (one woman could not say whether she had lost 5 or 6 children) had died upon gardens in the Duars. Four of these women stated that they had lost no children, but three of them were quite young and had only become mothers comparatively recently, and possessed but a single child each. One woman with three living children stated that she had lost none.

It is significant that of the fourteen infants we had under observation six died within six months.

IX.—SANITATION.

Within the last year or so, owing to an increased general interest, certain measures of anti-malarial sanitation have been adopted here and there in the Duars; and although they have in the main been more or less lacking in systematic application, they appear to have had, in the case of European residents at least, a very noticeable effect in improving the health of the community. Measures against native malaria, however, cannot be considered to be adequate to the situation, or to have affected to any great extent the incidence of the disease among natives.

But the prevalence of native malaria in an intense form is the primary condition making the climate unhealthy for Europeans; and it also forms the one real bar to satisfactory colonisation of the whole tract. It is also responsible for the fact that only certain classes of labour can be employed, while at the same time it reduces the efficiency of even this labour in a very marked degree. Anti-malarial sanitation and efficient prophylaxis for the native population must therefore be considered the chief sanitary problem of the district and requires the most careful consideration.

DRAINAGE AND ANTI-LARVAL OPERATIONS GENERALLY.

Selection of suitable sites for dwellings.—The situations of coolie lines vary very greatly in the relation to anopheles breeding places. Many lines have streams running through them, others are as far removed from running or stagnant water as it would be possible to place them: but as we have pointed out, malaria is equally prevalent in all. We believe that only in very few cases would the selection of line sites so as to avoid anopheles breeding places, have any marked effect in reducing malaria under the existing conditions.

Gardens with abundance of high land usually have their coolie lines built on sites possessing good natural surface drainage, but on many gardens on lower land it would be a matter of great difficulty, if not impossible, to suggest sites for lines more favourable as regards the danger from malaria than those already occupied. Only in spe-

cial parts of the district is it possible to find sites removed more than 400 yards from anopheles breeding places; and in this very portion we have seen that malaria is just as rife as in the apparently more unfavourably situated areas.

Drainage.—Where swamps or marsh lands exist it might be possible by circumferential or other systems of drainage to reduce the breeding places of anopheles, but this would often necessitate the stoppage of rice cultivation, and the initial outlay and cost of maintenance would be heavy, and so great in the case of gardens where swamps are numerous as practically to prohibit such measures on a scale likely to prove of any benefit.

In the case of many streams it might be possible to train the edges and by arranging the pebbles and boulders to confine the water to one channel, and perhaps prevent the formation of isolated pools. Also such pools when formed could often be filled in with sand or stones; but though such operations might prove of value in special cases they cannot have a very wide or general application, and it is not likely in existing circumstances that work of this kind would have any appreciable effect in reducing malaria.

Petrolage.—For small streams and for more or less permanent collections of water spraying at regular intervals with kerosene would be an excellent method of treatment, but the wide extent of ground to be covered and the systematic and thorough treatment necessary is a matter not generally appreciated. There is a tendency among the planting community to arrange for some absurdly inadequate measure such as the appointment of a man to “oil the streams” and to rest satisfied that this will have some effect. All such systems of attempting to combat malaria are to be deprecated since they are not only themselves useless, but give rise to a false idea of what should be done. In the general run they may be likened to the now rightly ridiculed practice of placing a saucer of eondy’s fluid on the floor of a room to disinfect the air. We have, however, seen one very thorough attempt in the Duars to combat malaria on these lines carried out by a very keen and capable planter, but as noted elsewhere the measure served only to demonstrate the difficulties to be encountered.

General effect of anti-larval operations.—Whilst in special circumstances it may be desirable to treat by drainage, training of streams, or petrolage, some large source of anopheles within a quarter or half a mile of a bungalow or coolie lines, we do not believe that any general attempt to reduce malaria in the Duars by anti-larval operations would have the slightest effect. The conditions met with offer very great difficulties.

The area involved on even the smallest gardens, the changing nature of the breeding places, the torrential character of the streams and the jungly conditions of many portions of the country have to be considered. It must be remembered also that labour is everywhere at a premium at the very time when such measures would require to be carried out on a large scale, and there is little doubt that were the tea gardens to undertake, however energetically, anti-malarial operations on these lines the scheme would result in failure and disappointment. The crux of the whole matter lies not in the question as to whether anti-larval measures could, or could not, be made effective (for the treatment of any breeding place can be ensured by sufficient expenditure and attention), but in the impossibility of carrying out such measures in the Duars under the most hopeful conditions as regards money and labour that is ever likely to be available for this purpose.

It would be no advantage to the tea community to demonstrate experimentally that malaria could be combated by such means in some particular spot. The tea industry is concerned, not in the improvement of one particular garden, but in the bringing about of a better condition throughout a wide district; and if by concentrating its energies on a single garden it were to produce effects, the problem of malaria in the Duars would still be untouched, for it is certain that they could not extend operations of the necessary thoroughness generally through the district. The sources of anopheles in the Duars would be very difficult to control, and the effect of only partial measures would be unimportant, for in districts of this nature nothing short of absolute extinction would appear to offer much hope of reducing malaria by measures directed against anopheles. Fortunately perhaps no attempt on a large scale involving great expenditure has been made on these lines in the Duars.

QUININE PROPHYLAXIS.

A considerable proportion of the gardens have made large purchases of quinine in tabloid form for the purpose of instituting quinine-prophylaxis among their coolies. But the measures that have been usually adopted have generally lacked system and method, and success or failure in producing an appreciable effect upon the incidence of malaria has been proportionate to the care employed in quinine distribution; for quinine prophylaxis on the scale required even on a small garden necessitates much care, thought and organization.

At present we know of no garden in which quinine prophylaxis has been carried out in such a manner as to reach the portion of the population whom it is most desirable to reach, and among whom its effects are likely to produce the greatest benefit. In general where quinine prophylaxis has been attempted the administration of the drug has been almost entirely confined to coolies actually turning out to work, the weakly, the sick and the young children receiving little or no attention. Under such a system the result, if apparent, can only be partial and very disproportionate to the expenditure involved. And though it is a promising sign that some attempt to combat malaria should have been made there is a general want of appreciation as to—

- (a) The scale upon which action must be undertaken.
- (b) The necessity for an efficient organisation and proper supervision.
- (c) The importance of reaching the classes of the population who suffer most frequently and become the most dangerous disseminators.
- (d) The value of a properly directed system as calculated to give both the best results and to enable the actual improvement to be demonstrated and recorded.

In the majority of instances which have come under our notice the duty of quinine administration has been handed over to a *babu* possessed of little knowledge and no idea as to how to perform the work; and as a result of casual and inconsequent methods of distribution great

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waste has followed and but little success has been attained. Such efforts can only lead to disappointment and final abandonment as valueless of a measure which, under expert advice and direction and with proper organisation, appears to offer, *in conjunction with better attention to the material wants and the comfort of the coolie*, the most likely solution of the problem of Duars' malaria.

PREVENTION OF MALARIA AMONG EUROPEANS.

Already a number of European bungalows in the Duars have been partially protected with wire gauze screens to doors and windows. But in many cases the protection afforded is very limited or used in so perfunctory a manner as largely to nullify its value. It is our impression that a very undesirable economy is often exhibited on this matter, a single room being screened while the verandah, which during the greater part of the year is most used, is left unprotected.

The removal of collections of native huts from the vicinity of bungalows has in a few cases been effected, and the improvement has in this respect led to little or no inconvenience, and has been carried out at small cost, the majority of the native houses being of such a temporary nature. Some gardens have adopted petrolage; but we know of no instance in which this measure is being carried out at the present in a manner which can produce any result. In no case, except the one to which we have previously alluded, has the magnitude of the work or the difficulties to be overcome been at all understood.

The most efficient measure of prophylaxis, and one which has been largely adopted by the Europeans in the Duars, public opinion having recognised its value, is the habit of taking quinine daily in 5 grain doses. Tabloids are almost universally used and in many of the sub-districts only a small minority of European residents fail to make use of this remedy or complain of any difficulty in doing so. In our experience 5 grains of quinine taken daily has, after the first week or so, no apparent physiological effect; and we have ourselves taken this dose for many months at a time without experiencing any.

ill result. A dose of 15 grains or even 10 grains twice a week is, on the contrary, much more difficult to remember and more trying in its effects and it does not appear to give such good results.

The benefits of systematic quinine prophylaxis have been so marked among Europeans during the past year that the value and practicability of this method we think has been definitely proved.

This measure, together with efficient protection of bungalows generally, so that a man need not be exposed to infection either in his own house or when visiting friends, should give Europeans resident in the Duars the power to minimise the so-called climatic effects of the district.

GENERAL SANITATION.

General arrangements regarding sanitation in the Duars and especially arrangements for water-supply are very backward. In certain posts of the districts near the hills mountain springs have been tapped and water led for several miles to the gardens; but the number of gardens supplied in this manner is limited, as few are so favourably placed as to be able to obtain water in this way. In some of these cases the water is led in pipes to taps or small tanks in the different lines and in some facilities for washing are given. Such arrangements are, however, rarely met with in the Duars and form striking exceptions to the general want of attention to the subject of water-supply.

It is safe to say that with very few exceptions the garden water-supplies consist of primitive shallow wells, streams, springs, and so on. Quite commonly coolies are dependent for their water on holes in the bed of a river or upon water taken from the nearest *jhora*. Such sources of supply are used indiscriminately for washing and latrine purposes. It is quite common to see coolies getting water from a stream in which a few yards further up clothes are being washed. A walk along the bank of the bed of such streams invariably demonstrates their habitual contamination by fæces, since at all times of the year, and especially during the dry season it is evident that such places are practically latrines. Nevertheless such contaminated sources of supply are in daily use and appear to pass without

comment on the part of those responsible for the direction of the garden.

In other cases out of deference to an idea that something resembling a well should be provided, wooden boxes, iron cylinders or earthen well-rings have been sunk for from two to twelve feet in the soil usually in or near a stream bed.

Where the sole source of supply is from *kutchha* wells or water-holes these are often sunk in the midst of a coolie line, often within a few feet of houses and cattle sheds.

As the dry season advances and greater and greater difficulty is encountered in getting water, all the evils of such insanitary arrangements become markedly increased. Even for physical wants the supplies are not infrequently insufficient, leading to much hardship and a tendency to make use of water that would otherwise be scrupulously avoided. Conditions which appear to casual inspection passable will often be found on careful examination to be far from satisfactory. Coolies will be seen, for instance, carrying water from long distances and enquiry will show that they are debarred from the use of nearer supplies which have been practically commandeered by the older coolies. In one case we learned of eleven coolies, just up from their country, who left the garden the day after their arrival on account of difficulties they encountered regarding a supply of water. In this instance there was a well some 70 feet deep and the only other available supplies were about a mile away. The difficulty was that the older coolies already using this well would not allow the new-comers to draw water.

Every now and again it happens that severe outbreaks of cholera occur on a garden and steps are then taken to improve matters. This has led to some gardens using water pumped from wells into cisterns and distributed by pipes to the different lines. But although some supplies of this kind are good, in the others the wells are open to pollution, a fact which does not usually appear to receive the least attention or consideration. In parts of the district the water level is far below the surface and wells require to be sunk in a depth of from 50 to

90 feet. A few of these wells are excellently built, but in no instance have we seen draw wells of this nature provided with proper means for raising the water.

Some gardens situated in the lower parts of the district in most instances as a result of outbreaks of cholera, have lately been making use of Norton tube pumps. The pumps are, however, too few in number for the population; and in no instance, where they have been seen, have they been sunk with proper precautions, and no measures have been taken to prevent contamination or waste water percolating through the extremely porous soil to the base of the pump tube.

X.—MALARIA AND BLACK-WATER FEVER AMONG EUROPEANS IN THE DUARS.

Malaria among Europeans in the Duars is a secondary phenomenon dependent upon the widespread existence of the disease among the native population, the health of a scattered European community such as that to be found in a tea district being a good index, until its members learn to protect themselves, of the actual conditions relative to malaria to be met with among the natives surrounding them. When, therefore, we find that European residents suffer very severely from recurring ill-health, dependent upon frequent malarial infections, we can predict with certainty that malaria is very prevalent among the general population with whom they are brought into close relation. Examination has shown that in the Duars we have no exception to this rule.

In this district the European lives in circumstances entirely different from those encountered in many parts of India, where Europeans live without taking any precautions against malaria and yet escape infection entirely or for long periods, for the resident in the Duars is exposed to the certainty of almost daily inoculation through the bites of infected anopheles. The man who does not adopt precautions in these circumstances either almost invariably suffers from recurring attacks of fever or becomes the subject of more or less masked symptoms of malaria. If not actually ill he is almost always on the verge of becoming so, and constantly complains of being liverish, troubled with bile, feeling off colour, and so on, symptoms often indicating more or less modified attacks of malaria, usually of the malignant tertian type. In circumstances like these the Europeans are said to suffer from "the effects of climate", and after a year or two of such a life become liable to be attacked by black-water fever. This condition is the result of a change brought about in his blood by the effects of constant and repeated infections with malaria.

We have dealt fully with this side of the question in another report, and it is not necessary to go into further details here beyond saying that wherever a European is exposed to malarial infection in hyper-endemic areas, we may expect him to become liable to suffer

from black-water fever. Hyper-endemic areas may be defined as regions in which the endemic malarial index is maintained at 50 per cent. or over throughout the year. The Duars is such an area and there are others to be found in various parts of India. The distribution of black-water fever in India is the same as that of hyper-endemic malaria. But areas in India at present not hyper-endemic may become so as the result of labour aggregation, and we have good reasons for believing that new foci of black-water fever will result from time to time as circumstances lead to the formation of new hyper-endemic areas.

The question of black-water fever in a district, therefore, resolves itself into one of anti-malarial sanitation especially directed to the prevention of the disease among Europeans, a subject we have dealt with in the last chapter.

XI.—SUMMARY OF CHIEF CAUSES AT WORK IN BRINGING ABOUT A CONDITION OF INTENSE MALARIA IN THE DUARS AND THE POSSIBLE REMOTE EFFECTS OF THIS CONDITION.

(1) The Duars is not merely *malarious* ; it is an area of malaria hyper-endemicity, *i.e.*, the conditions more or less general throughout the year are those rarely seen except when malaria is epidemic. The endemic index of malaria ranges from 50 per cent. to 100 per cent. and remains persistently high from year to year throughout the whole district, and a very large portion of the adult population suffers more or less constantly from the disease.

(2) Black-water fever among Europeans, Bengalis, and to a less extent among the coolies, is one of the consequences of hyper-endemic malaria.

(3) The explanation of the special intensity of malaria in the Duars is to be found in the fact that it is an example on a large scale of the tropical aggregation of labour, a condition which plays an important rôle in the epidemiology of malaria in the tropics and especially in India.

(4) What largely determines existing conditions in the Duars is its labour system. Indirectly it is also this system which prevents the use of any but the best class of labour such as that recruited from Chota Nagpur.

(5) One of the chief causes leading to increased intensity of malaria in the Duars is the fact that at the commencement of their life in the district all new coolies are placed under the disadvantages imposed by the present labour system. The defects in the system as they affect malaria are—

- (a) The burdening of the new coolie from the very outset of life in the Duars, when all his resources are necessary to enable him to combat malaria successfully, with the repayment of debts largely incurred in the course of his recruitment.
- (b) Want of direct relations between the planter and the coolie, the position held by the "*sardar*" and the making of

garden *sardars* responsible for losses connected with the coolie, thus almost necessitating the attempt on the part of the *sardar* to recoup himself as far as possible indirectly, or directly from the coolies he controls.

- (c) The lack of compulsory registration of vital occurrences resulting in a general want of knowledge regarding the actual amount of sickness and mortality in the Duars.
- (d) The absence of any arrangement for the "protection of the coolie" especially new-comers, particularly in relation to—
 - (a) Arrangements to ensure drawing of subsistence allowance when sick.
 - (b) Arrangements for adequate treatment when sick.
 - (c) Arrangements to ensure a due proportion between pay and prices of food.
 - (d) Absence of all sanitary precautions or efforts to prevent the bad effects necessarily the outcome of uncontrolled aggregation.
- (6) These defects work chiefly by entailing—
 - (1) An inadequate dietary in the case of new coolies leading to the vicious cycle of—inadequate diet—physiological poverty—increased liability to sickness especially to malaria—less wages earned—increased hardship and privation with still less adequate diet, and so on.
 - (2) Hardship due to inability to provide themselves with many things which, if not absolutely necessary to life, are at least essential for physiological well-being, *e.g.*, good housing sufficient clothing and other comforts.
 - (3) Sickness entailing the introduction of a train of vicious-cycles ending in the deterioration of labour and the frequent partial or complete loss of the labourer as an active worker.
 - (4) Difficulty so induced in working a garden with such labour leading to the existence of large coolie populations only a portion of whom actually work with any regularity, and the

necessity for excessive immigration with its attendant increase in the incidence of malaria.

(7) All new coolies entering the Duars have to pass through a process of "acclimatisation" which includes, besides immunisation to malaria, their habituation to absolutely new and often hostile conditions. Only races inured to hardship can combat such a combination successfully and many even of these succumb. In such circumstances no natural increase of even the most prolific and hardy races can take place.

(8) In the Duars general sanitation is practically non-existent, questions regarding water-supply and other matters being usually arranged without sanitary knowledge and without reference to expert opinion, or to precautions which sanitary science has shown to be necessary.

(9) Anti-malarial sanitation presents two problems in the Duars: (a) the prophylaxis of malaria among European residents which is comparatively easy; and (b) the reduction of native malaria, which is very difficult.

European prophylaxis is already making way and the adoption by a large number of European residents of the precaution of taking 5 grains of quinine daily, the protection in some cases of bungalows, and increased care in the use of the mosquito net, has apparently led to a marked reduction in malaria among Europeans during the past eighteen months.

In regard to native malaria mosquito destruction or anti-larval operations offer no hope of even partial success. Far more hopeful are operations involving the adoption of—

- (a) Active measures to ascertain all malign influences affecting the coolie in his new home, and the taking of steps to combat these and to ensure the general prosperity and comfort of the new coolies.
- (b) Quinine prophylaxis on a basis organised under expert direction.

- (c) The automatic reduction of the factor of *non-immune immigration* by these means leading to—
- (1) Diminished loss of life and labour in the district, reducing the amount of annual immigration necessary.
 - (2) Increased efficiency of the labour forces and a greater proportion of the total garden population turning out to work.
 - (3) Permanent colonization by coolies in good circumstances able to combat malaria successfully.
 - (4) Breaking off the vicious cycle at present holding sway by which increased immigration means increased malaria and consequent increased immigration.
- (10) The remote effects to be considered are—
- (1) The drain on the best labour available in Bengal.
 - (2) The possibility of the formation of *foci* resulting from the return of infected persons to the recruiting districts from which they were drawn, with the result, in some specially favourable circumstances, of great epidemics of malaria in districts now comparatively healthy.

APPENDIX I.

List of endemic indices on a number of gardens in the Duars.

Gardens.	Race.	Month.	Number of children.	Spleen rate.	Parasite rate.
<i>Dam Dim District.</i>				Per cent.	Per cent.
Ellenbari	(a) Paharias ..	September ..	20	95	75
	(b) Madchhis ..	September ..	46	80	87
Washabari .. ..	..	October ..	50	78	60
Bagracote .. ..	..	September ..	68	67	72
Phulbari .. ..	..	August ..	66	92	62
Pathajora .. ..	..	October ..	40	78	65
Manabari .. ..	..	October ..	30	90	83
Ranacherra .. ..	..	October ..	100	89	82
Rungamutty .. ..	..	August ..	69	90	58
Mean Glas—					
(a) Bungalow lines ..	..	August ..	27	93	78
(b) Factory lines ..	..	August ..	33	91	91
Butibari .. ..	..	August ..	28	96	75
Dewars lines .. ..	..	August ..	25	92	90
Narkati .. ..	..	October ..	50	84	96
Bullabari .. ..	..	October ..	104	89	86
Moneys Hope .. ..	..	August ..	26	92	85
Sissibari .. ..	..	September ..	40	93	90
Hati-jungle .. ..	..	..	..	..	..
Barons—					
(a) Hazodcherr .. ..	..	October ..	44	89	93
(b) Jamadars .. ..	..	October ..	50	90	94
(c) North Grant	Coles and Santals	October ..	28	82	93
Hyapatha .. ..	..	January ..	25	96	88
<i>Chelsa District.</i>					
Chalonni	(a) Paharias ..	August ..	25	72	52
	(b) Chota Nagpuris ; Santals.	August ..	25	72	52
Sam Singh .. ..	..	December ..	40	55	35
Kilcot .. ..	..	December ..	44	95	83
Indong .. ..	..	February ..	16	87	87

List of endemic indices on a number of gardens in the Duars—concl'd.

Gardens.	Race.	Month.	Number of children.	Spleen rate.	Parasite rate.
<i>Nagrakata District.</i>					
Luksan	August ..	17	Per cent. 99	Per cent. 82
<i>Dina-Torsa District.</i>					
Biniguri	November ..	53	..	70
Huntapara	April	33	..	70
Lankapara	April .. ..	..	50	20
Dulsingpara	May .. ..	..	75	60
Huldabari	November ..	34	85	94
Telepara	November ..	112	95	89
Gayakuta	November ..	96	93	85
Hindupara	November ..	25	100	96
Gundyapara	November ..	108	83	73
Lakhubari	November ..	34	91	94
<i>Torsa District.</i>					
Jalgon	May	40	75	60
<i>Jalpaiguri.</i>					
Nayabusti	September ..	36	61	36
Jalpaiguri Town	September ..	20	40	25

APPENDIX II.

Tabular statement of results of observations on vital occurrences in a test line.

House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation end of November.	Number of persons.	BIRTHS.				DEATHS.		Entering garden.	Leaving garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.	First 3 months.	Second 3 months.							
1	Man .. Wife. Child, 5 years. Child, 2 years. Old coolies. Youth. New coolie.	5	..	5	New wing built. Youth and a wife occupying it.	6	..	..	..	..	..	..	1	..	..	..	5	..	..
2	Man with phthisis Wife. Boy, 8 years. Oedema. Child, 4 years. Child, 2 years. Old coolies.	5	Man and boy both worse.	5	.... Man died in October. Boy died a week later.	3	..	..	..	2	..	..	..	..	..	..	5	..	..
3	Man .. Wife. 4 children. Old coolies.	6	Young child very ill; intense anæmia and sores.	6	New-born baby, one month old.	7	..	1	..	..	..	..	..	..	..	..	6	..	..
4	3 men .. New coolies.	3	One woman extra	4	One man gone recruiting.	3	..	..	..	..	..	..	1	1	..	..	..	3	1

House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation end of November.	Number of persons.	BIRTHS.		DEATHS.		Entering garden.	Leaving garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.							
5	Man .. Wife. Old coolies. 3 men. New coolies.	5	Two women extra	7	<i>Statu quo</i> ..	7	..	..	..	..	2	..	..	..	2	3	..
6	2 men .. 2 women. New coolies.	4	<i>Statu quo</i> ..	4	One man and one woman gone to their country.	2	..	..	..	..	..	2	..	..	..	4	..
7	Man .. Wife. Child. Infant. Old coolies.	4	Two more men from house No. 10.	6	One new coolie and one old coolie gone recruiting.	4	..	..	..	..	..	2	2	..	4	..	..
8	Empty house	..	House fallen down	..	....	..	..	..	..	..	..	..	..	..	..	..	..
9	Man .. Wife. 2 children. Man. New coolies.	5	Original occupants gone to another garden. People from house 38 moved in. Husband died of cholera; woman and child went to another line. <i>Vide</i> 38 house burnt down.	..	....	..	..	..	1	..	..	7	8	..	5	..	..
10	3 men .. New coolies.	3	One man died. The two others moved into house 7.	..	House empty	1	2	..	3	..

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11	2 men .. 2 women. New coolies.	..	4	Child born	..	5	Another child born ..	6	1	1	4	..
12	2 men .. 1 woman. New coolies.	..	3	<i>Statu quo</i>	..	3	<i>Statu quo</i> ..	8	3	..
13	Man .. Wife. Child. Infant. 2 men. Old coolies.	..	6	<i>Statu quo</i>	..	6	<i>Statu quo</i> ..	6	..	..	..	..	..	..	..	..	..
14	Man .. Wife. Child. Old coolies.	..	3	<i>Statu quo</i>	..	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	..	..	..
15	Man .. Wife. 3 children. Old coolies.	..	5	<i>Statu quo</i>	..	5	Mother gone to her country. One girl gone to relatives in another line. One new woman from another garden.	4	..	1	2	..	..	..	..	..	1
16	Man .. Wife. 2 children. Man. Wife. Old coolies.	..	6	<i>Statu quo</i>	..	3	One man gone recruiting.	5	..	..	1	..	..	..	..	..	1
17	Man .. Wife. Old coolies.	..	2	<i>Statu quo</i>	..	2	New piece added to house 8 feet square. Woman from "bus-tee" (garden lines not on garden ?).	3	..	1
18	Woman 2 youths. Child. Old coolies.	..	4	<i>Statu quo</i>	..	4	One youth left garden	3	1

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House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation, end of November.	Number of persons.	BIRTHS.		DEATHS.		Leaving garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.						
19	Man .. Wife. Old coolies.	2	<i>Statu quo</i> ..	2	<i>Statu quo</i> ..	2	..	..	..	..	..	..	..	2	..	..
20	2 women 2 children. Old coolies.	4	<i>Statu quo</i> ..	4	<i>Statu quo</i> ..	4	..	..	..	..	..	..	3	4	..	..
21	Man .. Woman. 3 youths. Woman. Child. Old coolies.	7	One man and three women in addition. Woman and child to another house.	9	One woman to another part of lines.	8	..	..	..	..	4	..	..	7	..	..
22	Man .. Wife. 2 boys. Old coolies.	4	<i>Statu quo</i> ..	4	Wife gone to her country. One son gone to house 23.	2	..	..	..	..	1	..	1	4	..	1
23	Man .. New coolie.	1	Man gone ? 2 women come in.	2	One woman gone to another garden. Youth and wife from house 22.	3	..	..	..	..	2	1	..	..	1	..
24	Man .. Woman. 2 children. Old coolies. Man. New coolie.	5	Man gone ?	4	Husband gone recruiting. One child emaciated moribund.	3	..	..	..	..	2	..	..	4	1	1
25	Man .. 3 women. Child. Old coolies.	5	<i>Statu quo</i> ..	5	One woman gone to her country.	4	..	..	..	..	1	..	..	5	..	1

26	Man .. New coolie.	1	An extra man, new coolie.	2	<i>Statu quo</i> ..	2	..	..	..	1	..	1	..
27	2 men .. Woman. Child. Old coolies.	4	<i>Statu quo</i> ..	4	Man, woman and child gone to country.	1	..	..	..	..	4	..	3
28	Man .. Woman. 2 children. Old coolies. Man. New coolie.	5	Man gone to house 29.	4	Former occupants gone to country. Man and 2 women from house 32.	3	..	..	3	1	4	1	4
29	Man .. Wife. 2 children. New coolies.	4	One extra man from house 29.	5	One man gone recruit. ing.	4	..	..	1	..	4	4	1
30	Man .. Wife. Child. Old coolies.	3	<i>Statu quo</i> ..	3	<i>Statu quo</i> ..	3	..	..	..	..	3	..	..
31	2 women Old coolies.	2	<i>Statu quo</i> ..	2	One woman gone to another garden two women from anther line.	3	..	..	1	..	2	..	..
32	Man .. 4 women. New coolies.	5	<i>Statu quo</i> ..	5	Man and 2 women to house 28	2	..	..	..	3	..	5	..
33	Man .. 2 women Old coolies.	3	Man and woman from house 33.	5	Another man and wo- man moved in. One woman gone to coun- try. One woman to another house.	5	..	..	1	4	3	..	1
34	2 men .. 2 women. 3 children. Infant. New coolies.	8	<i>Statu quo</i> ..	8	<i>Statu quo</i> ..	8	..	..	..	..	..	8	..

House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation end of November.	Number of persons.	BIRTHS.		DEATHS.		Entering garden.	Leaving garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.							
35	2 men .. 2 women. Infant. Old coolies.	5	Child dead ..	4	One man gone recruiting.	3	..	1	..	..	..	1	..	5	..	..	1
36	Man .. Woman. Child. Old coolies.	3	<i>Statu quo</i> ..	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	..	3	..	..	..
37	Man .. Woman. 2 children. Old coolies.	4	One new man, new coolie.	5	New coolie gone recruiting.	4	..	..	..	1	1	..	..	4	..	..	..
38	2 men .. 2 women. Child. New coolies.	5	House burnt down. One man and woman gone to house 53, others to house, No. 9.	..	....	..	..	..	..	..	..	..	5	..	5	..	..
39	Man .. 2 women. Child. Infant. Old coolies.	5	<i>Statu quo</i> ..	5	<i>Statu quo</i> ..	5	..	..	..	..	..	..	..	5	..	..	..
40	Woman Youth. 3 children. Old coolies.	5	<i>Statu quo</i> ..	5	<i>Statu quo</i> ..	5	..	..	..	..	..	..	..	5	..	..	..
41	Man .. Woman. Child. Old coolies.	3	<i>Statu quo</i> ..	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	..	3	..	..	..

House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation end of November.	Number of persons.	BIRTHS.				Entering garden.	Leaving garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.							
52	Man .. 2 women. Child. Old coolies. 1 woman. New coolie.	5	1 woman gone away (new coolie).	4	Woman from another garden moved in.	5	..	..	..	..	1	1	..	..	4	1	..
53	2 men .. Woman. New coolies.	3	Another man and woman from house 38.	5	One woman gone to house 60. One man and one woman gone.	3	..	..	..	..	..	..	2	3	..	3	..
54	Man .. Woman. 2 children. New coolies.	4	House fallen down as result of heavy rain. Occupants gone to house 59.	..	....	..	..	..	..	..	..	..	..	4	..	4	..
55	Man .. Woman. Child. Old coolies.	3	<i>Statu quo</i> ..	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	..	..	3	..	..
56	Man .. Woman. Old coolies.	2	<i>Statu quo</i> ..	2	Child born ..	3	..	1	..	..	..	..	..	..	2	..	..
57	Man .. 2 women. 2 children. Infant. Old coolies.	6	Child aged 4 and infant both dead. Woman gone to another garden.	3	<i>Statu quo</i> ..	3	..	..	2	..	..	1	..	..	6	..	..

58	2 men .. Woman. Infant. Old coolies.	4	Infant emaciated	4	Child dead. Mother had died and the infant had been fed by another woman.	3	..	..	..	1	..	..	4	..	..
59	Man .. Woman. 2 children. Old coolies.	4	<i>Statu quo</i>	4	<i>Statu quo</i> ..	4	..	..	..	..	..	..	4	..	..
60	Man .. Woman. 2 children. New coolies.	4	<i>Statu quo</i>	4	One woman from house 53. Man and woman from another garden.	7	..	..	2	..	1	..	..	4	..
61	Man .. Woman. Child. Old coolies.	3	<i>Statu quo</i>	3	Man gone recruiting ..	2	..	..	..	1	..	..	3	..	1
62	2 men .. Woman. 2 children. Infant. Old coolies.	6	<i>Statu quo</i>	6	Infant dead	5	..	..	1	..	..	..	6	..	..
63	3 men .. 2 women. New coolies.	5	<i>Statu quo</i>	5	Woman gone to an- other house.	4	..	..	..	..	..	1	..	5	..
64	Man .. Woman. 2 children. Old coolies.	4	<i>Statu quo</i>	4	One child aged 12 died.	3	..	..	1	..	..	..	4	..	..
65	Man .. Woman. Infant. Old coolies.	3	<i>Statu quo</i>	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	3	..	..
66	Man .. Woman. Old coolies.	2	Child born in Au- gust died shortly after.	2	Man gone recruiting ..	1	1	..	..	1	..	..	2	..	1

House number.	First observation end of May.	Number of persons.	Second observation end of August.	Number of persons.	Third observation end of November.	Number of persons.	BIRTHS.				DEATHS.				Entering garden.	Changing into house.	Changing out of house.	Old coolies.	New coolies.	Gone to country.
							First 3 months.	Second 3 months.	First 3 months.	Second 3 months.	First 3 months.	Second 3 months.	First 3 months.	Second 3 months.						
67	Man .. Old coolie. Man. New coolie.	2	One man gone elsewhere-house 70.	1	The other man gone to bustee. New arrivals from another garden man, woman and 4 children.	6	..	..	..	..	6	1	..	1	1	1	1	1	1	..
68	Man .. 2 youths. Old coolies.	3	<i>Statu quo</i> ..	3	<i>Statu quo</i> ..	3	..	..	..	..	..	..	..	..	..	..	..	3	..	..
69	Man .. Woman. Old coolies.	2	Child born ..	3	Original people gone to country. People from house 80 moved in.	5	1	..	..	..	..	3	..	3	3	..	..	2	..	2
70	House empty ..	..	People from house 73 moved in. Woman died. Man from 67 and another woman.	3	<i>Statu quo</i> ..	3	..	..	1	..	1	..	..	3	..	..	..	..	..	..
71	Man .. Old coolie.	1	<i>Statu quo</i> ..	1	<i>Statu quo</i> ..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..
72	Man .. Woman. New coolies.	2	Woman died in August from childbirth. Child died some time later.	1	<i>Statu quo</i> ..	1	1	..	2	..	..	..	..	..	..	..	..	..	2	..
73	Man .. Woman. Old coolies.	2	House empty	Man moved in from another garden.	1	1	2	2	2

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